AD-A069 089 SYSTEM DEVELOPMENT CORP EATONTOWN NJ F/G 9/2
U.S. ARMY DEFENSE SYSTEMS COMPUTER RESOURCE REQUIREMENTS (1978 --ETC(U)
FEB 79 D ROSA DAAB07-76-C-0334
UNCLASSIFIED CORADCOM-76-0334-F NL

| OF |
AD A069089

END
DATE FILMED
6-79
DDC

LEVEL II

AD A069089

DDC FILE COPY

RESEARCH AND DEVELOPMENT TECHNICAL REPORT
CORADCOM-76-0034-F

# US ARMY DEFENSE SYSTEMS COMPUTER RESOURCE REQUIREMENTS ( 1978 - 1990 )



Donald Rosa
SYSTEMS DEVELOPMENT CORP
Eatontown, N. J.

Interim Report for Period January 1977 - December 1977

February 1979



Prepared for:
Center for Tactical Computer Sciences

**CORADCOM**
**US ARMY COMMUNICATION RESEARCH & DEVELOPMENT COMMAND**
**FORT MONMOUTH, NEW JERSEY 07703**

Info. on
Mr. Henry E. Rose
Systems Dev. Corp
Paoli town, N.J.
Contract should be:
DAAB07-76-C-0334
mt

# NOTICES

## Disclaimers

The citation of trade names and names of manufacturers in this report is not to be construed as official Government indorsement or approval of commercial products or services referenced herein.

## Disposition

Destroy this report when it is no longer needed. Do not return it to the originator.

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

# REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

| | |
|---|---|
| 1. REPORT NUMBER: CORADCOM-76-0034-F | 2. GOVT ACCESSION NO: 76-0334-F |
| 3. RECIPIENT'S CATALOG NUMBER: | |
| 4. TITLE (and Subtitle): U.S. Army Defense Systems Computer Resource Requirements (1978 - 1990), Interim Report | 5. TYPE OF REPORT & PERIOD COVERED: Research Report Jan - Dec 1977 |
| | 6. PERFORMING ORG. REPORT NUMBER: |
| 7. AUTHOR(a): Donald Rosa (SDC) | 8. CONTRACT OR GRANT NUMBER(a): DAAB07-76-C-0034 |
| 9. PERFORMING ORGANIZATION NAME AND ADDRESS: Systems Development Corporation, Eatontown, New Jersey | 10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: 1L162701AH92 |
| 11. CONTROLLING OFFICE NAME AND ADDRESS: 542 8305 Interim rept. Jan-Dec 77 | 12. REPORT DATE: February 1979 |
| | 13. NUMBER OF PAGES: 81 |
| 14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office): Center For Tactical Computer Sciences (CENTACS), CORADCOM, DRDCO-TCS-BC, Fort Monmouth, New Jersey 07703 | 15. SECURITY CLASS. (of this report): Unclassified |
| | 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE |

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

DAAB07-76-C-0334

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

This report is an interim report on Computer Resources Requirements of the U.S. Army. Subsequent reports will be issued as completed.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

COMPUTER MARKET SURVEYS, TACTICAL COMPUTER S STEM REQUIREMENTS.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Twenty Army tactical computer based systems were surveyed to determine Army embedded computer system requirements during the period 1978-1990. The survey was conducted by means of personal interviews with system developers and by means of a questionnaire. Results indicate Army Requirements for 52,250 computers for these 20 systems surveyed. Results were extrapolated for a total of 135,000 computers required for 130 systems.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

TABLE OF CONTENTS

LIST OF FIGURES

## TABLES

# 1. INTRODUCTION AND EXECUTIVE SUMMARY

1.1 SCOPE. This is an interim report documenting the findings of an Army survey to identify the U. S. Army Defense Systems computer resources requirements for the 1980's time frame. It is an interim report because it covers only an initial group of twenty computer-based systems of an estimated total of 120 to 140 Army Defense computer-based systems. That data combined with the data in this interim report will comprise the final report on the computer resource requirements for the 1980-1990 time frame.

1.2 OBJECTIVE. The objective of this survey is to determine the U. S. Army Defense Systems computer embedded resources requirements (hardware/software) with respect to time and to collect information describing current and proposed Army Defense computer-based systems and how they interface on the battlefield.

1.3 APPROACH. The approach taken to satisfy the survey objective is identified in the following subparagraphs.

a. Identify the Army Defense computer-based systems in various stages of the life cycle; such as, Conceptual Phase, Validation Phase (Advanced Development), Engineering Development Low, Rate Initial Production (LRIP) or Limited Procurement (LP), Full Scale Production and Deployed.

b. Define the major computer resource elements (hardware/software) for which the information is to be collected. Data on computer resource elements were collected as shown in paragraph 1.4.2 and as further broken out in Section 3.

c. Develop a questionnaire to be employed in personal interviews with Army Defense computer-based system developers. The questionnaire is to be used as a guide for the interviewer.

d. Conduct personal interviews.

NOTE - In many cases, the data obtained may be based on estimates only (both the interviewee's and/or the interviewer's).

(1) Conduct personal interviews with Army Defense computer-based system developers, starting with those consulted in developing the Military Computer Family (MCF) application requirements.

(2) Conduct personal interviews with other Army Defense computer-based system developers/planners to supplement the data obtained above.

e. Collect, analyze, and compile the data obtained in the above interviews. Data is summarized and presented in graphical, tabular, or matrix form. Systems are described by a series of annotated diagrams indicating system configuration, interfaces with other systems, deployment within the division or corps, participation in closed loop systems, and communications requirements.

f. Prepare Interim Report. The results obtained from this computer resources requirements survey are documented in this interim report.

## 1.4 SUMMARY

### 1.4.1 Computer Based Systems

For the initial survey, it was decided to concentrate on the Fort Monmouth area. This resulted in SDC conducting twenty interviews from 17 May 1977 to 31 August 1977. The systems interviewed are shown in Table 1-1. (NOTE - Table 1-1 is provided under separate addendum.)

In selecting which system to interview, it is important to consider where the system appears in the system acquisition cycle as shown in Figure 1-1. Systems in the conceptual phase are very loosely defined and highly subject to change and therefore are not apt to provide accurate and reliable data. In the Validation Phase (Advanced Development Model) and even more so in the Full Scale Development Phase (Engineering Development Model), the information obtained is much more accurate, more reliable, less subject to major changes, and more readily available. Systems that are deployed tend to provide good technical data but have little need for computer resources into the 1980's unless a major retrofit or upgrading is being planned. It is therefore best to select systems in the Validation Phase (AD models) or the Full Scale Development Phase (ED or LP/LRIP models).

Ninety-five percent (95%) of the systems covered in this interim report fall into that category, i.e., 25% AD models, 40% ED models, and 30% LP/LRIP models. This is shown in Figure 1-2. Another point to consider is that in the Validation Phase there may be a competitive "shoot-off" between two or more developers. In this case, one system version may be selected as the "sample" since it may become quite involved and confusing to attempt to report on more than one version of the same system.

TABLE 1-1. LIST OF TWENTY INTERVIEWS CONDUCTED

The information contained in this table is classified FOR OFFICIAL USE ONLY and is contained in an addendum to this report.

# SYSTEM ACQUISITION CYCLE

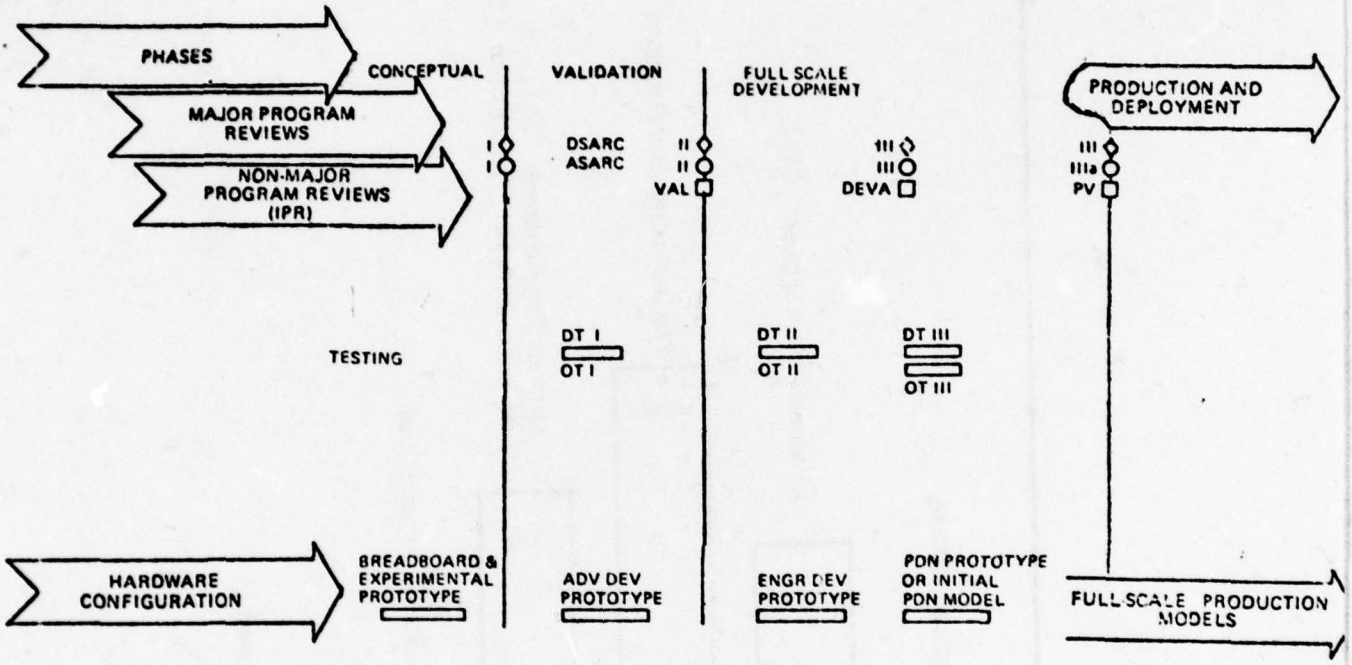


Figure 1-1 System Acquisition Cycle

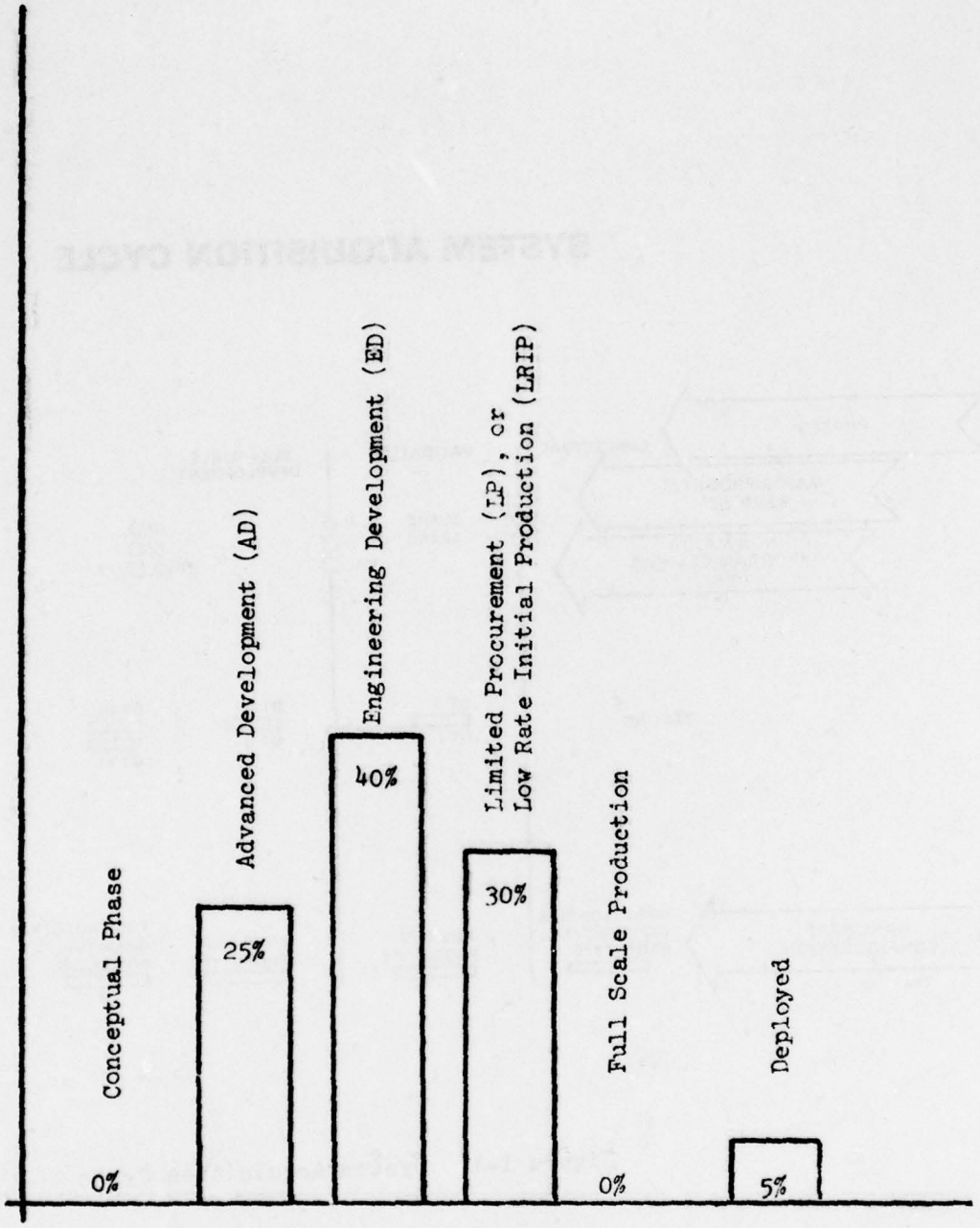


Figure 1-2 Acquisition Status of Systems Covered In This Report

1.4.2 Computer Resources. The major computer resource elements are broadly categorized into two groups - hardware and software. The computer hardware resources are computer (CPU, main memory, and input/output), secondary memory, tertiary memory, printers, display devices, and intelligent terminals. The computer software resources are functional support software, general support software (general support services), operating system services, post deployment support software, and applications software. The above hardware and software computer resource elements are further broken out and defined in Section 3.

1.4.3 Interview Process. The interview process is detailed in Section 4 of this report. Basically, the steps in the interview may be briefly summarized as follows:

* Initial personal contact is made prior to the actual interview
* The interviewer and the interviewee prepare for the interview
* The actual interview is conducted
* Post-interview research is made to finalize the questionnarie and extract data required for later analysis
* PMO review cycle (optional)

1.4.4 Computer Resource Requirements (FY 1978-FY 1990). The total computer hardware resource requirements (FY 1978 - FY 1990) are presented in Section 5 for the initial systems and in Section 6 for the total number of systems (computer requirements only).

The following observations are very apparent after reviewing the data collected for the initial twenty systems with respect to computer hardware resource requirements.

a. The requirement for MAXI computers is minimum - in this case, non-existent. MIDI and MINI configurations are being employed. There is a very large requirement for MICRO computers, being used in some cases as the prime computer itself in small portable or airborne systems and as supplemental computers within system components, i.e., sensors, data terminals, displays, etc.

b. Secondary memory requirements are being handled primarily by disk storage. The need for drum storage in the twenty systems surveyed is non-existent.

c. Tertiary memory is being satisfied primarily by cartridge type tape drives. There is only minimum use of reel and cassette units.

d. The majority of the printer requirements are being met through the use of either low-speed or medium-speed printers. There was no requirement for high-speed printers in any of the twenty systems surveyed.

e. The need for displays is very common. Requirements are for all sizes (small screen, medium size screen, and large screen). The demand for interactive features and graphics is also apparent in the twenty systems surveyed.

f. Most of the requirements for intelligent terminals are of the portable, i.e., small, lightweight, hand-held, man-pack type.

The above summary of the computer hardware resources requirements for the 1980's (based on twenty Army systems) is shown in Table 1-2 and is broken out on a per-year basis in Tables 5-1 through 5-5 in Section 5 of this report.

A review of the computer software resource requirements as indicated on the twenty system questionnaires shows the following characteristics:

a. The majority of the systems interviewed are using mechine oriented (assembly) language (MOL), or some combination of MOL and a higher order language (HOL) for the applications software. Only 15 percent of the systems interviewed use HOL exclusively.

b. The size of the applications software is under 10,000 source statements for 37% of the systems; 10-100K for 53%; and over 100K for 10%.

c. Forty percent of the systems surveyed could not specify the cost for the development of their applications software. The remainder estimated the cost per instruction as shown below:

Up to $25 (15 percent of the systems)

$25 to $50 (25 percent of the systems)

$50 - $100 (20 percent of the systems)

d. Most of the systems (greater than 50 percent) use Functional Support Software consisting of simulators, assemblers, compilers, and debugging aids.

e. Sixty percent of the systems reported that batch and interactive source language editors were the most commonly used General Support Software. However, forty percent of the systems answered "unknown" on the entire subject of General Support Software.

f. By far, most systems (75 percent) use a real-time operating system.

g. Most of the post deployment support software falls into two groups: fault detection and isolation, and diagnostic programs. Fifteen percent of the systems answered "unknown" on this subject.

Graphs representing the data collected with respect to the computer software resources requirements are further defined in Figures 5-1 through 5-7 in Section 5 of this report.

TABLE 1-2

Computer Hardware Resource Requirements for the 1980s

| CATEGORY | INITIAL NUMBER OF SYSTEMS | TOTAL NUMBER OF SYSTEMS |
|---|---|---|
| Computers: | | |
| MICRO | 50117 | 72000 |
| MINI | 1439 | 8900 |
| MIDI | 850 | 2100 |
| MAXI | - | - |
| Secondary Memory: | | |
| SMALL DISK | 1073 | |
| MEDIUM DISK | 36 | |
| LARGE DISK | - | |
| Tertiary Memory: | | |
| CASSETTE | 149 | |
| CARTRIDGE | 3872 | |
| REEL | 167 | |
| Printers: | | |
| LOW SPEED | 960 | |
| MEDIUM SPEED | 1921 | |
| HIGH SPEED | - | |
| Displays: | | |
| SMALL SCREEN | 2781 | |
| MEDIUM SCREEN | 1249 | |
| LARGE SCREEN | 479 | |
| Intelligent Terminals | | |
| PORTABLE | 27884 | |
| CONSOLE | 700 | |

## 1.5 REPORT ORGANIZATION

This report is organized in seven sections. Section 1 is the introduction and executive summary providing a brief description of the scope, objective, approach, and an overview of the Army Computer resources requirements for the 1980's.

Section 2 identifies the initial set of computer-based systems that comprise this interim report and their acquisition life cycle status.

Section 3 defines the major computer resource elements (hardware/software) for which information was collected.

Section 4 describes the questionnaire employed in the personal interviews with Army Defense computer-based system developers. In addition, this section provides details of the interview process.

Section 5 provides the results of an analysis performed on the data compiled during the interviews. The data is presented in tabular and graphical form.

Section 6 extends the results presented in Section 5 (the initial 20 systems) to estimate the computer resource requirements for a total of 130 systems.

Section 7 contains a copy of the actual questionnaire used in the surveys.

## 2. COMPUTER BASED SYSTEMS

2.1 INITIAL SYSTEMS. A list of twenty-three Army Defense computer-based systems was established and twenty-three interviews scheduled. The list of scheduled interviews is shown in Table 2-1 along with the acquisition status of each of the twenty-three systems. The list of twenty-three scheduled interviews was reduced due to two interviews (#6 and #7) being cancelled by the interviewee and not rescheduled at this time. The remaining twenty-one scheduled interviews were conducted and the twenty-one completed questionnaires submitted to CENTACS. However, this interim report will cover only twenty systems since one system was terminated a few weeks after the interview was conducted. The list of the twenty initial systems making up this interim report is shown in Table 1-1 (see separate addendum to this report for Tables 1-1 and 2-1.)

TABLE 2-1. LIST OF TWENTY-THREE SCHEDULED INTERVIEWS

The information contained in this table is classified FOR OFFICIAL USE ONLY and is contained in an addendum to this report

2.2 TOTAL SYSTEMS

An attempt was made to estimate what the total U. S. Army defense systems computer resources requirements will be for the period FY 1978 to FY1990. That is, if all the data were now available as a result of all system surveys (rather than only the initial twenty in this interim report), what would the final report indicate?

To accomplish this estimate, the starting point was the DARCOM list of 134 systems entitled "Inventory of Computers in Army Defense Systems". The list was received on 23 March 1977 and lists 134 systems. The list was scanned, eliminating systems that either: are already covered in this interim report, are duplicates, are completely unknown, are not applicable, or are studies - not systems. This resulted in reducing the list from 134 systems to 92 systems. The 92 systems are shown in Tables 2-2a through 2-2j, in accordance with their major functional category (see addendum to this report).

These 92 systems were then reviewed to estimate (based on their assumed mission, system size, and deployment structure) the size and quantity of computers that would most likely be used, i.e., MICRO, MINI, MIDI, and MAXI. This resulted in the computer quantities shown in Table 6-1 based on a total of 112 systems (the initial 20 plus these 92). The MAXI computer category is not included since its use was too insignificant to consider.

This estimate for 112 systems is only an initial count and should be modified based on two assumptions. First, it should not be assumed that the DARCOM list which provided the basis for the above initial estimate is complete. Therefore,

it was decided to increase the initial estimate by 20 percent. This resulted in the revised estimate shown in Table 6-1 for 130 total systems (92x1.2 + initial 20).

The second assumption involves the use of multi-computers within systems; that is, due to operational constraints or reliability/availability requirements, certain systems may require either multi-computer operation or duplex (back-up) configurations. Reviewing the data collected for the initial twenty systems shows that multi-computers within systems occur mostly in the MINI and MIDI class. Furthermore, the data collected indicated that 10 percent of the MINIs and 40 percent of the MIDIs were being used in a multicomputer or redundant mode. The second assumption was to assume that approximately the same results would occur for the remaining systems yet to be surveyed. This resulted in the revised estimate of computer quantities as shown in Table 6-1 for "130 Adj" systems.

The information contained in the following tables is classified FOR OFFICIAL USE ONLY and is contained in an addendum to this report:

a. Table 2-2a - Field Artillery (FA) Systems

b. Table 2-2b - Close Air Support (CAS) Systems

c. Table 2-2c - Air Defense (AD) Systems

d. Table 2-2d - Command Systems

e. Table 2-2e - Electronic Warfare (EW) Systems

f. Table 2-2f - Intelligence Systems

g. Table 2-2g - Maneuver Systems

h. Table 2-2h - Logistics Systems

i. Table 2-2i - Common Systems

j. Table 2-2j - Miscellaneous Systems

3. COMPUTER RESOURCES. In general, computer resources refers to the totality of computer equipment, computer program, computer data, associated documentation, personnel, and supplies (reference DOD Directive 5000.29). Specifically, this survey addresses computer resources as contained within two broad areas: i.e.,

* Hardware Resources (paragraph 3.1)

* Software Resources (paragraph 3.2)

3.1 Hardware Resources. Computer hardware resources covered in this survey consists of the following electronic equipment:

* Computer (paragraph 3.1.1)

* Secondary Memory (paragraph 3.1.2)

* Tertiary Memory (paragraph 3.1.3)

* Printers (paragraph 3.1.4)

* Display Devices (paragraph 3.1.5)

* Intelligent Terminals (paragraph 3.1.6)

* Other Peripherals (paragraph 3.1.7)

Each of the above equipments is further broken down into sub-categories as identified in the following paragraphs (3.1.1 through 3.1.6)

In Section 5 of this report, the above hardware resources requirements are presented as quantities required per year for the years FY 78 through FY 90.

3.1.1 Computer

The computer, embedded within each system being surveyed, is basically a device that is capable of accepting information, applying prescribed processes to the information, and providing the results of these processes. In this survey, the computer is considered to consist of the Central Processing Unit (CPU), the Input/Output Unit (IOU) and the Main (primary) Memory Unit (MMU).

The computers surveyed were partitioned into four categories, i.e., Micro, Mini, Midi, and Maxi. The distinction between the categories is defined in figure 3-1.

In general, Micro-computers will have 4, 8 or 16-bit word lengths and relatively long execution times. The 4-bit micro is mainly used to handle very small processing functions, like those performed by a calculator or a small on-line instrument. The 8-bit general purpose micro is the most widely used type in microcomputing systems. The 16-bit micro resembles a mini computer and may be somewhat regarded as a lower cost minicomputer. In function and structure, the microcomputer is similar to the minicomputer with the main differences being price,

| CATEGORY | EXAMPLE | WORD SIZE (BITS) | PROCESSING SPEED (KOPS) | 1977 SIZE |
|---|---|---|---|---|
| MICRO | LSI-11 | $\leq$ 16 | $<$100 | 1-3 chips/CPU |
| MINI | UYK-19/20 | 16 | 200-600 | 1-3 PCBs/CPU |
| MIDI | UYK-7, GYK-12 | 32 | 300-600 | 4-8 PCBs/CPU |
| MAXI | | $\geq$ 32 | $>$600 | Not Available |

Figure 3-1 Distinction Between Computer Categories

size, speed of execution (less than 100 KOPS) and computing power.

Minicomputers usually have word lengths of 18-bits or less (but may vary from 8 to 24-bits) with 16 bits being the most common. Processing speed is in the range of 200 to 600 KOPS.

Midi computers use 24 or 32-bit words and are usually far less expensive than the Maxi and frequently out-price and out-perform the mini by delivering much higher throughput at comparable prices. As defined here, the midi is not a widely used group, as is the mini-computer group.

A maxi computer is what is more commonly known as a large scale computer (system) typically characterized by large main storage and secondary storage units, high speed computation ($\geq$ 600 KOPS), many input-output channels, and several peripheral devices (displays, printers, etc.). Word length is typically equal to or greater than 32 bits.

The criteria for assigning a computer to one of the above four categories (micro, mini, midi, and maxi) was established in accordance with three factors; word size, processing speed, and 1977 size. Figure 3-1 shows the "general guidelines" that were applied. The determination for KOPS was taken from Rein Turn's "Computers in the 1980's" as the reciprocal of (.7 x Add Time + .3 x Multiply Time) x 1000, i.e., KOPS = $\frac{1}{.7\ t_{ADD} + .3\ t_{MULT}}$ where $t_{ADD}$ and $t_{mult}$ are in microseconds.

3.1.2 Secondary Memory. Secondary memory represents storage facilities divorced from the computer itself but holding information in the form required by the computer. It is under the control of the computer but the data to be operated upon must be transferred from secondary memory to internal (main) storage before operations commence and the data is usually returned to secondary storage after operations are completed. Secondary storage devices usually have larger capacities and slower access time than internal main storage (but not as slow as tertiary storage - paragraph 3.1.3). The most common forms of secondary memory used in Army systems today is the magnetic disk which provides very large storage capabilities at a cost somewhere between drum and magnetic tape with cost-per-bit generally lower than drum and higher than tape. The magnetic disk memory is second only to magnetic tape in its use for storing large quantities of information. Disk memory systems may be categorized by their storage capacity, i.e., small (up to 20 Mega-Bytes), medium (20 to 100 Mega-Bytes) and large (over 100 Mega-Bytes).

3.1.3 Tertiary Memory

Tertiary memory refers to a "third level" of storage, i.e., a level of storage twice removed from the main storage level and once removed from the secondary storage level. Tertiary memory is usually characterized by a relatively longer access time compared to secondary memory and especially with respect to main

or primary memory. The most common example of tertiary memory is magnetic tape storage.

In this computer resources requirements survey, tertiary memory is partitioned into three categories; cassette, cartridge, and reel with typical storage capacities of 10, 20, and 160 Mega-Bits respectively.

Cassette units are suitable for use in a wide variety of peripheral applications and as convenient substitutes for paper tape punches and readers. They are simple, small size, low cost, and easy to maintain. They are used where relatively low-volume (typically 10 Mega-Bits) data storage is required.

Cartridge units are used where higher storage capacity (typically 20 Mega-Bits, and greater reliability are required These units approach the recording density of typical reel-to-reel units, have the convenience of a snap-in recording media, and are much less expensive than the large conventional ½-inch wide, 10½-inch diameter open reel type computer tape systems. Cartridge units have a good performance/price ratio.

Reel-to-reel units are used where high-volume data storage (typically 160 Mega-Bits) is required. Generally, the reel-to-reel units provide about 16 times as much data storage as a cassette unit.

### 3.1.4 Printers

Printers provide the human-readable hard copy of computer data but since they are typically electromechanical, they are neither as fast nor as reliable as most purely electronic apparatus. The most common impact printers are generally of the bar (or wheel) or chain (belt) type. Non-impact type printers provide improved reliability and quieter operation but do not provide multiple copies, frequently use less readable fonts, and generally use more expensive paper. An example of a non-impact printer is the matrix printer, e.g., 5x7 dot matrix, where character like configurations of dots are printed through the proper selection of matrix points rather than through the selection of type faces. These non-impact matrix printers may be electrostatic, electromagnetic, or thermal types.

Regardless of impact vs non-impact, the printers surveyed were grouped into three broad speed related categories, i.e.; low speed, 10 to 300 lpm (e.g., teletype models 33 and 35 at 10 characters per second and 72 characters per line); medium speed, up to 1000 lpm (72-132 characters per line), and high speed operation at speeds equal to or greater than 1000 lpm (72-132 characters per line.

Low to Medium speed printers are generally of the "serial" type in which only one character is printed at time, similar to an electric typewriter or teleprinter. Medium to high speed printers may be the "line printer" type where the printer is capable of simultaneously printing one line of characters across a page (typically 72 to 132 characters/line) as continuous paper advances line by line in a direction past type bars or a type cylinder (drum) that contains all characters in all column positions. Very high speed printers may be of the "page printer" type which compose a full page of characters before printing the page (up to 132 columns or more).

Whenever possible, the computer resources requirements survey attempts to identify the printers along the general characteristics described above, either by notes on the questionnaire itself or by stating the manufacturer/ model number or the military type designation.

### 3.1.5 Display Devices

Computer-driven alphanumeric and graphic displays are a key element in a large variety of command and control systems not only in air defense applications but also in antisubmarine warfare, ground and air traffic control, strategic systems, and weapons control. The display system is generally configured around the type and number of viewers or operators.

This survey excludes simple numerical readouts, i.e., LEDs, liquid crystals, incandescents, gas discharge units, etc. These are designed primarily to portray numerical values (used singly or in assemblies).

The survey considers full alphanumeric devices that can display all 26 alphabetic characters, 10 numerics, and up to 28 punctuation marks or other symbols. These displays are usually ASCII - or EBCDIC - compatible and generally display up to 1000 characters. Displays that fall into this category include cathode ray tube (CRT) displays and flat panel displays.

Cathode ray tube displays provide a good visual interface at moderate cost when the amount of data to be viewed at one time is relatively large and the user desires page-like reproduction. These displays use straightforward extensions of basic CRT technologies. Color adds a further dimension to computer-generated graphics displays.

Most flat-panel displays are constructed by depositing electrodes or devices on a substrate fabricated from stable materials such as glass or ceramic. Flat panel displays are now being designed to become a part of many display systems, perhaps even replacing the CRT in some applications.

The plasma panel display may bridge the gap between presently used CRT displays which are limited to a maximum of 25 to 30 inch diameter and the 6 x 8 foot and larger wall display currently based on projection technology.

The display devices depicted in the computer resources requirements survey are presented in this report according to three groups based on size of display area. These three groupings are small screen size (up to 12 inches), medium screen size (12 to 25 inches) and large screen size (greater than 25 inches).

In addition, the survey indicates if the displays are interactive, alphanumeric only, or alphanumeric plus graphics. Other information concerning each particular display is included in the questionnaire where this information was able to be obtained. Where known, the manufacture and model number (or military nomenclature) are also provided in the questionnaire.

### 3.1.6 Intelligent Terminals

An intelligent terminal is usually, but not always, remotely located from its host computer and requires a man-machine interface. The intelligent terminal

is user programmable and may not be alterable by the user, i.e., allow software changes only at the factory, such as burning in a new read-only memory (ROM). Intelligent terminals contain processors (generally Micro-processors) which relieve the host computer of certain functions by providing such features as a wide range of editing capabilities, programmable transmission codes, limited data computational capability, automatic error detection and correction, etc. In some cases, intelligent terminals are grouped into two categories; "Portable" (i.e., typically under ten pounds, handheld, man-pack, etc.) and "console" (possible including CRTs, printer, keyboards, or other devices). An example of the portable category would be the Digital Message Device (DMD) and examples of the console category would be the AN/UGC-74 Intelligent Communications Terminal and the Tactical Computer Terminal (TCT).

3.1.7 Other Peripherals Devices

The computer resources requirements survey considers all computer peripheral devices not included in paragraphs 3.1.1 through 3.1.6 in a category labeled as "other". This group contains such computer peripherals as paper tape readers, paper tape punches, keypunch machines, plotters, card readers, card punches, consoles, non-intelligent terminals, etc. These devices, if they exist within surveyed systems are documented in the questionnaire itself but are not discussed in this report.

3.2 SOFTWARE RESOURCES. Computer software is a combination of associated computer programs and computer data required to enable the computer equipment to perform computational or control functions (reference DoD Directive 5000.29). This section of the Computer Resources Requirements survey addresses computer programs; specifically, those associated with the following:

- Functional Support Software (paragraph 3.2.1)
- General Support Software (paragraph 3.2.2)
- Operating System Services (paragraph 3.2.3)
- Post Deployment Support Software (paragraph 3.2.4)
- Applications Software (paragraph 3.2.5)

Most of the above software groupings deal with support software, i.e., that software used for producing, modifying, analyzing, and testing a computer-based system. These software groupings are further broken down into sub-categories as identified in sub-paragraphs 3.2.1 through 3.2.4.

3.2.1 Functional Support Software

Functional support software is that software that provides direct support to such major software development activities as the following:

a. Translate user needs into functional system requirements and allocate those functions to hardware, software, firmware, and people.

b. Develop functional design specifications.

c. Design the software and the requirements specifications.

d. Design and construct system acceptance test scenarios, drivers, and monitors.

e. Produce unit-tested software modules in accordance with the requirements specifications.

f. Integrate and test the unit-tested software modules in accordance with interface and subsystem specifications to validate the total system.

g. Receive, evaluate, and control engineering change requests and distribute configuration controlled systems to the users.

Examples of functional support software are discussed in the following subparagraphs;

3.2.1.1 Simulators. A general purpose simulator allows a user to construct a computer model of a real or proposed system and to perform simulation experiments to determine the behavior of the model under various operational conditions.

A computer system simulator has basic building blocks that represent real computer system components whose modeled behavior approximates the throughputs, capacities and access times achievable on the modeled equipments.

3.2.1.2 Data Base Design Aids. Data Base Design Aids are used to assist data base designers in grouping data elements into logical record classes and in determining the relationships among logical record classes implicit in either the nature of the data or the usage of the data.

3.2.1.3 Testing Aids. The types of testing aids that support the construction of system testing include:

a. Test Data Generators that create data files for testing and validating computer programs.

b. Test Data Auditors that compare data files against specifications and produce reports of discrepancies and/or compliance.

c. Test Case Design Advisors that analyze programs written in a high level language and present the results of that analysis in a form suitable to assist test case designers in the selection of test data.

d. Test Instrumenters and Analyzers, i.e., instrument modules under test so as to collect data characterizing the behavior of the module.

3.2.1.4 Assemblers. Assemblers allow programs to be coded in a symbolic language in which statements generally correspond to a single machine instruction.

3.2.1.5 Compilers. Compilers are used to translate programs written in a high level language into either relocatable object code acceptable to a linker or assembler.

3.2.1.6 Linkers. Linkers combine the text produced by separate invocations of compilers and assemblers ("object modules") into executable code strings ("load modules" or "core images") that can be loaded into the computer's main storage and executed without further pre-processing.

3.2.1.7 Debugging Aids. Debugging aids are used to assist the programmer in locating the sources of program errors that have been discovered during unit testing, usually by giving some control over the execution of the module under test that is external to the normal program code.

3.2.1.8 Performance Monitors. Performance monitors assist the programmer in quantifying the resource consumption characteristics of a program and in isolating performance-critical areas.

3.2.2 General Support Software (General Support Services) The primary function of general support software (general support services) is to provide a framework of common services that will allow the outputs of the functional support software (paragraph 3.2.1) to be stored, retrieved and inter-communicated. The following subparagraphs present examples of software that provides general support to all software development activities.

3.2.2.1 Data Base Management System. A data base management system allows the user of a computer system to define the contents of and the logical relationships between collections of data items that represent some useful abstraction of a real-world phenomenon without being concerned with the physical mechanics of storing, locating, and retrieving items or groups of items.

3.2.2.2 Text Processing Systems. These systems allow the maintenance of printed documents in machine readable form. In addition to the actual printed text of the document, the machine readable file generally contains control statements that specify the format of the finished document in terms of spacing, indentation, pagination, titling, and justification.

3.2.2.3 Editors, Source Language. Editors are programs that allow the user to add, delete, replace and alter the contents of individual data records within a file. They may be divided into interactive editors that are designed to be used in an on line, time-sharing mode, and batch editors that take their commands from control cards in the input stream.

3.2.2.4 Sort/Merge. This utility allows the user to rearrange the order of the logical records in one or more input files so that the records of the resulting output file are in order specified by the collating sequence of a series of one or more fields in each record.

3.2.2.5 Documentation Aids. Documentation aids assist in the preparation and maintenance of documentation about the modules of a system. Aids most relevant to a program development environment include text processing systems, flowchart construction languages and automatic flowcharters.

3.2.2.6 Information Retrieval Systems. Information Retrieval Systems are general purpose application programs operating either on-line (interactively) or in the batch that interpret user requests to locate and display information that is stored either within a structured database or within separate files. These systems can be classified either as query language systems or as report writers.

3.2.2 General Support Software (General Support Services) The primary function of general support software (general support services) is to provide a framework of common services that will allow the outputs of the functional support software (paragraph 3.2.1) to be stored, retrieved and inter-communicated. The following subparagraphs present examples of software that provides general support to all software development activities.

3.2.2.1 Data Base Management System. A data base management system allows the user of a computer system to define the contents of and the logical relationships between collections of data items that represent some useful abstraction of a real-world phenomenon without being concerned with the physical mechanics of storing, locating, and retrieving items or groups of items.

3.2.2.2 Text Processing Systems. These systems allow the maintenance of printed documents in machine readable form. In addition to the actual printed text of the document, the machine readable file generally contains control statements that specify the format of the finished document in terms of spacing, indentation, pagination, titling, and justification.

3.2.2.3 Editors, Source Language. Editors are programs that allow the user to add, delete, replace and alter the contents of individual data records within a file. They may be divided into interactive editors that are designed to be used in an on line, time-sharing mode, and batch editors that take their commands from control cards in the input stream.

3.2.3 Operating System Services. The Operating System (OS) Services present a "virtual machine" interface to the Function Support Software (Paragraph 3.2.1) and the General Support Software (Paragraph 3.2.2) and manages the real system hardware.

The Operating System is a collection of supervisory routines (usually user transparent) responsible for the allocation of system resources among the user tasks. These routines may include memory management, I/O handling, logging, storage assignment, operator interaction and job scheduling. Some typical Operating Systems are discussed in the subparagraphs below.

3.2.3.1 Basic Operating Systems (BOS). The Basic Operating System (BOS) runs single user processes from initiation to termination, may or may not overlap I/O with execution, and provides basic I/O support that allows the user to refer to files symbolically and to read and write them without knowing the hardware details of the I/O Interface. BOS provides basic batch supervisor

services that control normal and abnormal job termination, job to job transition, and operator communication. It provides a minimum base for program development by supporting at least one language translator and/or linker/loader.

3.2.3.2 Multiprogramming Operating System (MOS). A Multiprogramming Operating System (MOS) provides all of the services of the Basic Operating System while supporting the concurrent execution of two or more user jobs by allowing any special programming considerations in the user job. It prevents concurrently executing user jobs from accidentally or intentionally destroying each other or the supervisor.

3.2.3.3 Multiprocessor Operating System (MPOS). A Multiprocessor Operating System (MPOS) allows the computing load to be spread across more than one processor based on automatic (programmed) load-leveling algorithms or operator control, but does not require special case programming in the user job. Multiprocessor Operating Systems include the shared storage, loosely coupled, and networked types.

3.2.3.4 Time-Sharing Operating Systems (TSOS). A Time-Sharing Operating System (TSOS) is a variant of the multiprogramming operating system in which system resources are allocated to user jobs in such a way that all jobs appear to progress at the same rate. In addition, users are allowed to "interact" with and receive output from their jobs via terminals. Such systems are optimized for response rather than throughput or equipment utilization.

3.2.3.5 Real-Time Operating Systems (RTOS). Real-Time Operating Systems (RTOS) allow user jobs to be executed within specified short time limits.

3.2.3.6 Virtual Machine Monitor (VMM). With a Virtual Machine Monitor (VMM), the operating system presents an interface to the user program that makes it appear that the program is executing on a target computing system. Execution of the user program under control of the VMM must be identical to its execution on the target machine with the exception of timing dependent code. In general, the VMM must emulate the architecture with sufficient care such that the user program cannot discover (except through timing) whether it is executing in the target or virtual machine.

3.2.4 Post Deployment Support Software. Post-deployment support software is that software that provides direct maintenance support (both hardware and software) to the deployed computer system. Examples of some common types of post-deployment support software are discussed in the following subparagraphs.

3.2.4.1 Fault Detection and Isolation. A fault detection and isolation package consists of a comprehensive set of system checkout programs capable of recognizing equipment failures and diagnosing the cause to the level of the smallest field replaceable element for each equipment item. Fault detection and isolation when other functions are not being performed; or as called for by the operator to isolate a detected fault, or to perform testing during non-tactical operational periods.

3.2.4.2 Diagnostic Programs. Diagnostic programs are designed to aid in the detection of hardware and software malfunctions. Hardware diagnostic programs provide a means of detecting failures and facilitating rapid elimination of components demonstrating drastic or marginal problems. Software diagnostics include error statements produced by the executive routine that tell the programmer of a specific error or problem.

3.2.4.3 Trap/Trace Routines. Trap/Trace Routines are useful software debugging tools. Traps are halts inserted in object code that, when encountered during program execution, cause a branch to a specific location (breakpoint) in a program or sub-routine that facilitates debugging by requesting interrupt for manual evaluation and/or modification before continuing program execution.

Trace is a debugging tool that prints or displays a specific set of registers and/or memory locations as they are encountered throughout the execution of a program. Program execution is not interrupted, but a trace of the contents of key variables and registers is provided for later problem analysis.

3.2.4.4 Scenario Generators. Scenario generators are designed to simulate actual or near-actual system operational conditions. For example, a scenario generator may provide for the transmission/reception of messages to/from a system under test. This function may include extracting messages from a scenario tape, determining their time or scheduled transmission to the system under test, transmitting the message from the system under test.

3.2.5 Applications Software. Applications software is a series of interrelated routines and subroutines designed to perform a specific task. The cost of applications program development is directly related to the complexity of the application, the amount of software tools available, and to the number of source statements written.

In this section of the computer resources requirements survey, applications software was investigated on a per-system basis with respect to:

- o its approximate size, i.e., estimated number of source statements; and if known, its approximate cost per instruction to produce.

- o its use of machine oriented language (MOL) or some higher order language (HOL).

## 4. THE INTERVIEW PROCESS

The actual questionnaire used for the computer resources requirements survey was developed by System Development Corporation (SDC) and approved by CENTACS. The questionnaire contains over thirty-six pages with fifty-four questions, many of which are detailed and somewhat technical in nature. The questions are arranged in six categories (parts). See Section 7 for the actual questionaire used.

Part A, System Description - This section shows a pictorial representation of the system as well as a system profile. A system level block diagram is also included. Sixteen related questions dealing with the system, its requirements, and its acquisition are presented.

Part B, System Interfaces/Communications - This section highlights the external system interfaces as well as the internal subsystem interfaces. The communication requirements of the interfaces are also addressed. There are six questions in this section.

Part C, Major Computer Resource Elements (Hardware) - Part C contains sixteen questions discussing the hardware characteristics of the computer resources elements, i.e., processor; primary, secondary, and tertiary memory; printers, displays, intelligent terminals, and other peripheral equipments.

Part D, Major Computer Resource Elements (Software) - Part D contains eight questions requesting data concerned with the computer languages used, government regulations, and support software requirements, including post-deployment support requirements.

Part E, System Support Activity - This section contains four questions describing the maintenance support, configuration control, and the communication support responsibilities.

Part F, Automated Training Support Computer-Based System - This section discusses the major computer resource elements (hardware & software) used in automated training support of computer-based systems and devices. There are four questions in this category.

A letter was issued by DARCOM requesting participation in this survey and the establishment of points-of-contact. CENTACS supplied SDC with forty-two points-of-contact. Some of these were contacted by telephone. The purpose of this telephone contact was to set up a date for the interviewer to make an initial informal personal contact (not an interview) with the PM Office, explain the purpose of the survey, and to leave a copy of the questionnaire for preliminary review and interview preparation by the PM's personnel. At this time, the interviewer obtains as much information as possible describing the system, e.g., fact sheets, brochures, copies of view-graph briefings, etc. This enables the interviewer to better prepare himself for the upcoming interview and thus help the interview process to run smoothly.

After one to two weeks another telephone contact was made to schedule a mutually convenient appointment for the actual conduct of the interview itself. The actual interview requires from two to four hours depending on the type of personnel present at the interview and the extent of their preparedness as well as that of the interviewer. The average time was found to be approximately 3½ hours.

Since most interviewees were not able to provide all needed information, following each interview the interviewer (in most cases) had to research several missing answers to various questions and develop drawings, diagrams, etc. from whatever material could be found and made available. This activity proved to be extremely laborious and very time consuming but was considered to be necessary in order to provide an acceptable end product. If this were not done, there would be several unanswered questions on many of the questionnaires.

Most of the PM Offices requested that they be allowed to review and approve the finished (completed) questionnaire before it is submitted. This is a good procedure since it not only gives the PM a chance to see how the finished product looks in its entirety but also serves as a check on the accuracy of the answers, both those supplied by the interviewees and those supplied by the interviewer through his own estimates and/or research efforts. This procedure requires additional time to complete questionnaires but it is felt that the addition time is well worth the benefits derived from the PM's final review.

In summary, the interview process breaks down as follows:

a. Initial personal contact prior to actual interview (½ man-day).

b. Time for interviewer to prepare for the interview (1 man-day)

c. Actual conduct of the interview (½ man-day).

d. Additional post-interview research to finalize the questionnaire, ask additional questions, extract data, etc. (1½ - 2½ man-days).

e. PMO review cycle (optional)

This allows a total of 3½ to 4½ man-days per system or approximately 5 to 6 interviews/surveys per month (22 working days) per interviewer. It should be pointed out here that this rate of 5 - 6 interviews/surveys per month per interviewer is based on local interviews involving no travel time. Future interviews will require travel and the interview/survey rate per interviewer will necessarily be somewhat lower.

## 5. COMPUTER RESOURCES REQUIREMENTS PER YEAR (FY 1978 - FY 1990)

The actual data extracted from Parts C and D of the twenty questionnaires submitted in summarized in this section, primarily by the use of tables and graphs.

5.1 COMPUTER RESOURCE REQUIREMENTS - HARDWARE. The data associated with each of the computer resource hardware elements identified in paragraphs 3.1.1 through 3.1.6 is shown in Tables 5-1 through 5-5.

5.1.1 Computer Requirements per Year (Table 5-1). Table 5-1 shows that there is a large demand for MICRO computers as system computer in small portable man-pack systems and airborne units. They are also being widely used in sensors, data terminals, displays, control units, etc. For other than MICRO computer applications, the majority of the requirements are for the MIDI and MINI computer configurations. Of the initial twenty systems surveyed, there was absolutely no requirement for the MAXI computer. Thirty-five percent of the systems surveyed used the MIDI computer, 50 percent used MINI computers, 35 percent used MICRO computers, and 15 percent used a combination of two or more of the above.

| Computers | FY78 | FY79 | FY80 | FY81 | FY82 | FY83 | FY84 |
|---|---|---|---|---|---|---|---|
| MICRO | 312 | 518 | 697 | 4231 | 6165 | 4550 | 5446 |
| MINI | 26 | 29 | 120 | 129 | 141 | 159 | 153 |
| MIDI | 35 | 18 | 36 | 53 | 86 | 98 | 98 |
| MAXI | | | | | | | |

Note: 70% of the twenty computer systems surveyed use core memory (a total of 6368K bytes ranging in capacity from 32K bytes to 2048K bytes).

30% of the twenty computer systems surveyed use semi-conductor memory (a total of 252K bytes ranging in capacity from 256 bytes to 22K bytes).

| Computers | FY85 | FY86 | FY87 | FY88 | FY89 | FY90 | TOTAL |
|---|---|---|---|---|---|---|---|
| MICRO | 7150 | 15550 | 5498 | | | | 50117 |
| MINI | 192 | 192 | 136 | 56 | 56 | 50 | 1439 |
| MIDI | 112 | 112 | 88 | 72 | 42 | | 850 |

Table 5-1 Computer Requirements Per Year

NOTE: This table represents actual data collected for the initial twenty systems only.

5.1.2 Auxiliary Memory Requirements per Year (Table 5-2). Table 5-2 shows the requirements per year for both secondary memory (Disk) and tertiary memory (Cassette/cartridge/tape-reel). As indicated, there are no requirements at all for drum storage among the initial twenty systems. Only one system was found to use drums but since they have definite plans to change to disk, their secondary storage requirements were listed as disk. All of the 1,109 disk systems are less than 16 Mega-Bytes except for 36 units which are 80 Mega-Bytes.

Thirty-five percent of the systems surveyed have secondary storage requirements that are being satisfied by disks. The remaining 65 percent of the systems have no requirements for secondary storage.

Seventy percent of the systems surveyed require tertiary storage; 57 percent satisfying this requirement through the use of Cartridge tape drives which are being employed in quantity ratios of 12:1 over both reel and cassette combined.

5.1.3 Printer Requirements per Year (Table 3-3). As shown in Table 3-3, there are no requirements for high speed printers (greater than 1000 lpm). Medium speed printers (up to 1000 lpm) are being used 2:1 over low speed (10-300 lpm) printers. There were no printer requirements at all for 35 percent of the systems surveyed. The remaining systems were split approximately 50 - 50 between their need for low speed versus medium speed. The number of characters (columns) per line varies from 33 to 132 but is predominately 80 columns.

5.1.4 Display Requirements per Year (Table 5-4). There are requirements for all sizes of display devices, especially for the small screen (less than 12 inches) type. Eighty percent of the systems surveyed require display devices with approximately half specifying small screen and half specifying medium size screens. Of those systems having a need for display devices, 32 percent require interactive displays while 56 percent require interactive displays with graphics capability. Twelve percent do not require either interactive features or graphics capability. CRT type displays are used approximately 2:1 over plasma panel.

5.1.5 Intelligent Terminals Requirements per Year (Table 5-5). The need for intelligent terminals is evenly divided with 50 percent specifying the need and 50 percent declaring no such need. Sixty percent of those systems requiring intelligent terminals state their needs in the portable category, i.e., handheld, manpack, etc. The quantity of portable intelligent terminals far exceeds any other type or size by 16.1.

5.2 COMPUTER RESOURCE REQUIREMENTS - SOFTWARE. This paragraph discussed the computer resource software elements as identified in paragraphs 3.2.1 through 3.2.5 and as shown in Figures 5-1 through 5-7.

5.2.1 Applications Software Type, Size, and Cost (Figures 5-1 thru 5-3) As shown in Figure 5-1, most of the systems surveyed (60 percent) use Machine Oriented Language for the applications software, while only 15 percent use a Higher Order Language (HOL). Those systems using HOL reported using TACPOL, CMS-2, FORTRAN II, JOVIAL and ATLAS-EQUATE.

| Auxiliary Memory | FY78 | FY79 | FY80 | FY81 | FY82 | FY83 | FY84 |
|---|---|---|---|---|---|---|---|
| Secondary Memory | | | | | | | |
| Disk-Small | 34 | 17 | 67 | 58 | 81 | 102 | 98 |
| Disk-Medium | | 2 | | 3 | 1 | 6 | 6 |
| Disk-Large | | | | | | | |
| Tertiary Memory | | | | | | | |
| Cassette | 8 | 9 | 31 | 51 | 30 | 20 | |
| Cartridge | 140 | 42 | 128 | 405 | 766 | 520 | 359 |
| Reel | 8 | 8 | 19 | 24 | 20 | 20 | 8 |
| | | | | | | | |

NOTE: This table represents actual data collected for the initial twenty systems only.

| Auxiliary Memory | FY85 | FY86 | FY87 | FY88 | FY89 | FY90 | TOTAL |
|---|---|---|---|---|---|---|---|
| Secondary Memory | | | | | | | |
| Disk-Small | 154 | 154 | 146 | 56 | 56 | 50 | 1073 |
| Disk-Medium | 6 | 6 | 6 | | | | 36 |
| Disk-Large | | | | | | | |
| Tertiary Memory | | | | | | | |
| Cassette | | | | | | | 149 |
| Cartridge | 384 | 384 | 288 | 288 | 168 | | 3872 |
| Reel | 20 | 20 | 20 | | | | 167 |
| | | | | | | | |

Table 5-2 Auxiliary Memory Requirements Per Year

| Printers | FY78 | FY79 | FY80 | FY81 | FY82 | FY83 | FY84 |
|---|---|---|---|---|---|---|---|
| Low Speed | 47 | 26 | 82 | 80 | 160 | 135 | 77 |
| Medium Speed | 27 | 84 | 239 | 576 | 554 | 141 | 54 |
| High Speed | | | | | | | |
| | | | | | | | |

NOTE: This table represents actual data collected on the initial twenty systems only.

| Printers | FY85 | FY86 | FY87 | FY88 | FY89 | FY90 | TOTAL |
|---|---|---|---|---|---|---|---|
| Low Speed | 79 | 79 | 75 | 75 | 45 | | 960 |
| Medium Speed | 90 | 90 | 66 | | | | 1921 |
| High Speed | | | | | | | |
| | | | | | | | |

Table 5-3 Printer Requirements Per Year

| Displays | FY78 | FY79 | FY30 | FY81 | FY82 | FY83 | FY84 |
|---|---|---|---|---|---|---|---|
| Small Screen | 113 | 257 | 509 | 853 | 807 | 172 | 7 |
| Medium Screen | 34 | 6 | 37 | 28 | 77 | 118 | 150 |
| Large Screen | 4 | 2 | 14 | 3 | 26 | 56 | 56 |
| | | | | | | | |
| | | | | | | | |

NOTE:
Small Screen Displays: 44% are interactive and 22% provide graphics.
Medium Screen Displays: All are interactive and 75% provide graphics.
Large Screen Displays: All are interactive and provide graphics.

| Displays | FY85 | FY86 | FY87 | FY88 | FY89 | FY90 | TOTAL |
|---|---|---|---|---|---|---|---|
| Small Screen | | | | | | | 2718 |
| Medium Screen | 204 | 204 | 172 | 92 | 77 | 50 | 1249 |
| Large Screen | 56 | 56 | 56 | 50 | 50 | 50 | 470 |
| | | | | | | | |
| | | | | | | | |

NOTE: This table represents actual data collected on the initial twenty systems only

Table 5-4 Display Requirements
Per Year

| Intelligent Terminal | FY78 | FY79 | FY80 | FY81 | FY82 | FY83 | FY84 |
|---|---|---|---|---|---|---|---|
| Portable | 213 | 282 | 374 | 3420 | 5115 | 2880 | 2500 |
| Console | | 22 | 16 | 49 | 11 | 66 | 98 |

NOTE: This table represents actual data collected on the initial twenty systems only.

| Intelligent Terminal | FY85 | FY86 | FY87 | FY88 | FY89 | FY90 | TOTAL |
|---|---|---|---|---|---|---|---|
| Portable | 3100 | 7300 | 2550 | 50 | 50 | 50 | 27884 |
| Console | 146 | 146 | 146 | | | | 700 |

Table 5-5 Intelligent Terminal Requirements Per Year

Figure 5-2 shows that 53 percent of the systems surveyed reported that the size of their applications software (number of source statements) was in the range of 10K to 100K. Only 10 percent exceeded this figure while 37 percent were below this range.

Cost per instruction varied among those systems that replied to this question (40 percent of the systems surveyed could not answer this question). Fifteen percent of the systems that did respond to this question stated the cost per instruction as under $25, 25 percent stated $25 - $50, while another 20 percent indicated the $50 - $100 range. (See Figure 5-3).

5.2.2 Functional Support Software (Figure 5-4) The breakdown of the Functional Support Software is very widely distributed among the systems surveyed as shown in Figure 5-4. All twenty systems interviewed responded to this question - there were no negative replies. Assemblers, Debugging Aids, Compilers, and Simulators were the most predominate items required among the initial twenty systems surveyed.

5.2.3 General Support Software (Figure 5-5) The question on General Support was without a doubt one of the questions that created the most negative response. Forty percent of the systems could not respond. Most stated that they did not understand what was meant by "General Support Software." When the meaning was explained, these forty percent then responded that either they didn't use any, it wasn't defined yet, or that they just didn't know. For the remaining 60 percent of the systems surveyed that did provide a positive response, the replies were distributed as shown in Figure 5-5.

5.2.4 Operating System (OS) Usage (Figure 5-6) As shown in Figure 5-6, the operating system most widely being used is by far the Real-Time Operating System (RTOS) with 75 percent of those surveyed reporting this OS for their system.

5.2.5 Post Deployment Support Software (Figure 5-7) Most of the systems surveyed (85 percent) use Fault Detection and Isolation software as well as Diagnostic Programs. See Figure 5-7. Fifteen percent (three systems) of the twenty systems surveyed indicated as "unknown" or "not defined" in this area even though two of the three systems were in the Engineering Development (ED) Phase and should therefore have given some thought to the subject of post deployment support at this point. The other system was in Limited Rate Initial Production and couldn't specify any requirements for post deployment support software.

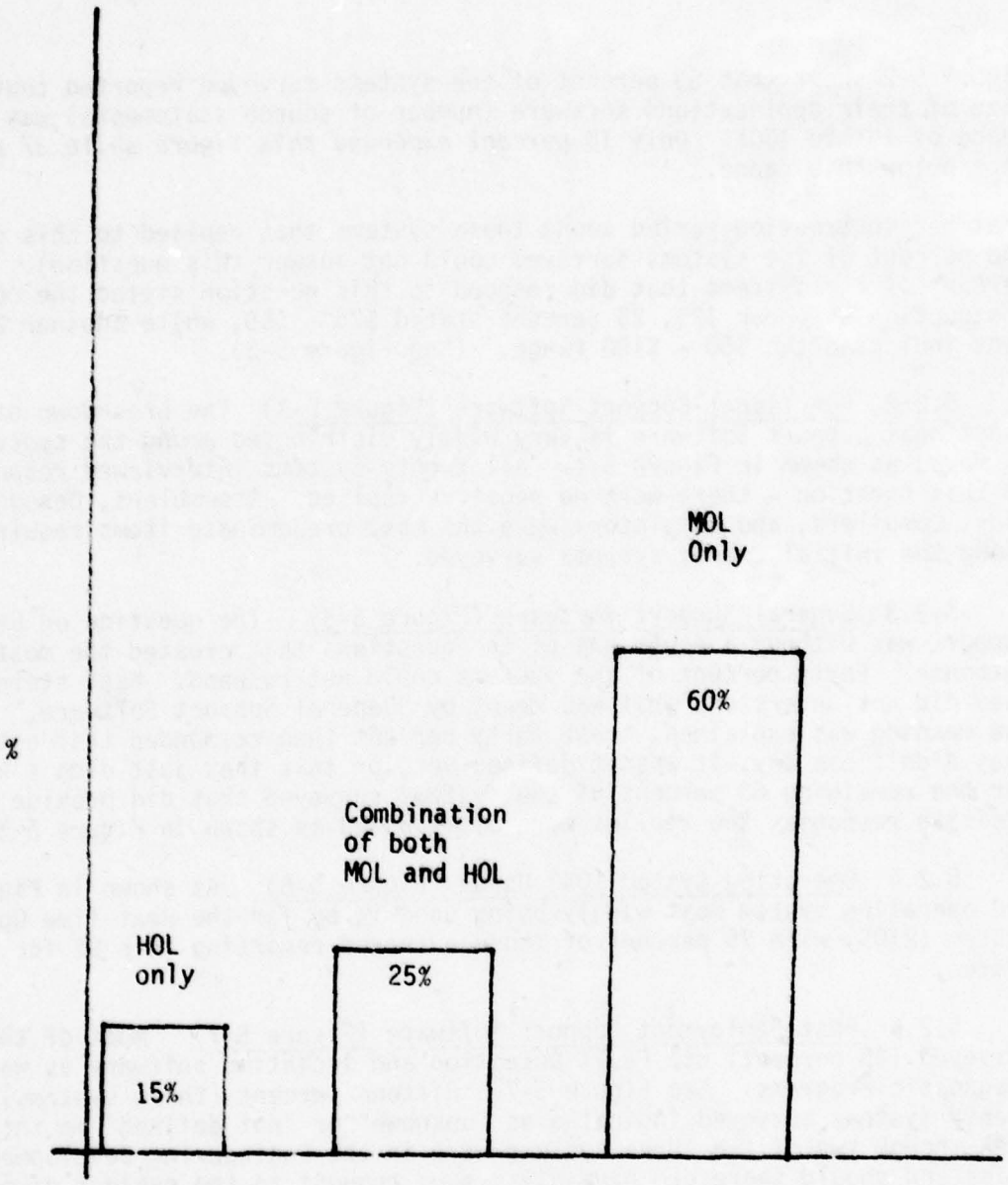


Figure 5-1 Breakdown of Systems Using HOL Only; Combination of Both MOL and HOL; and MOL Only.

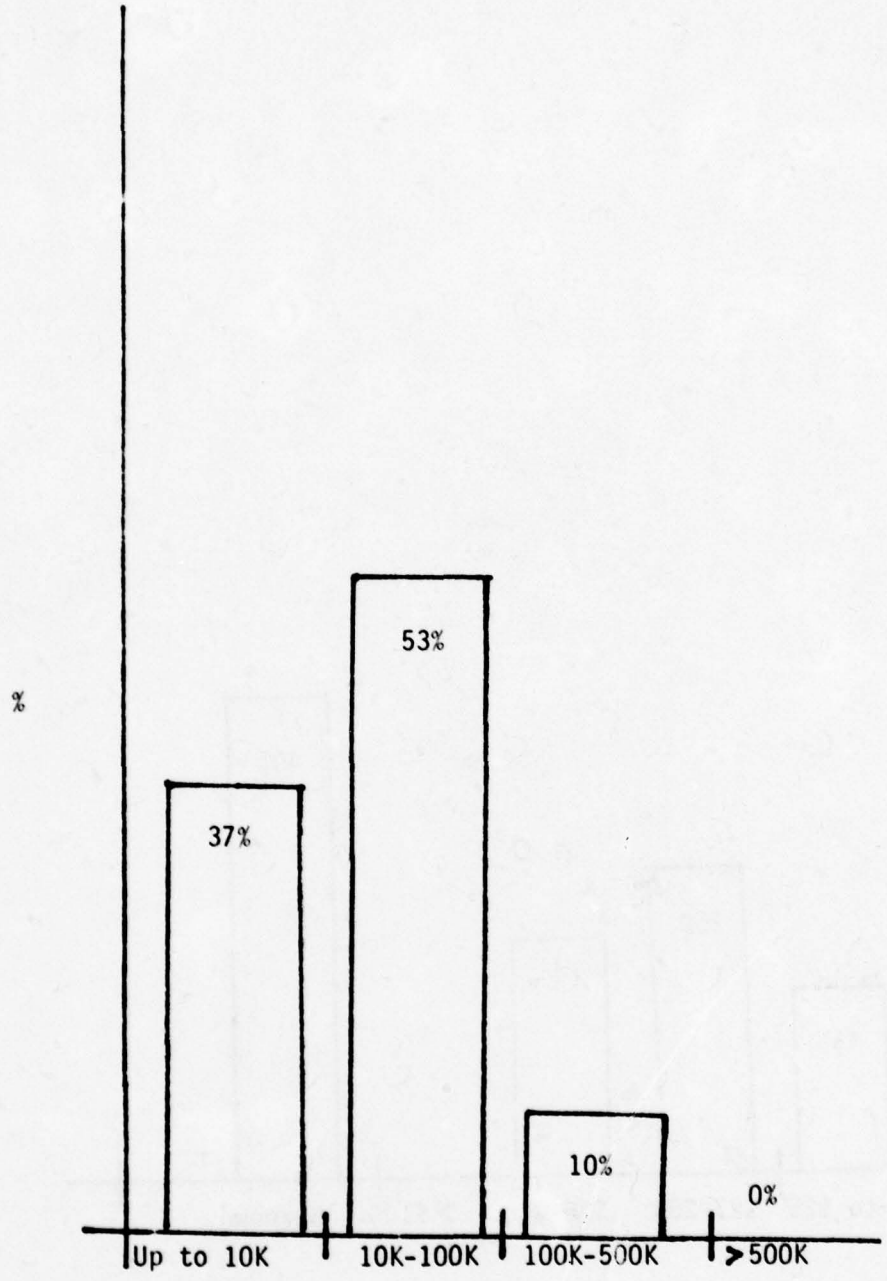


Figure 5-2 Breakdown of Applications Software Size (Number of Source Statements)

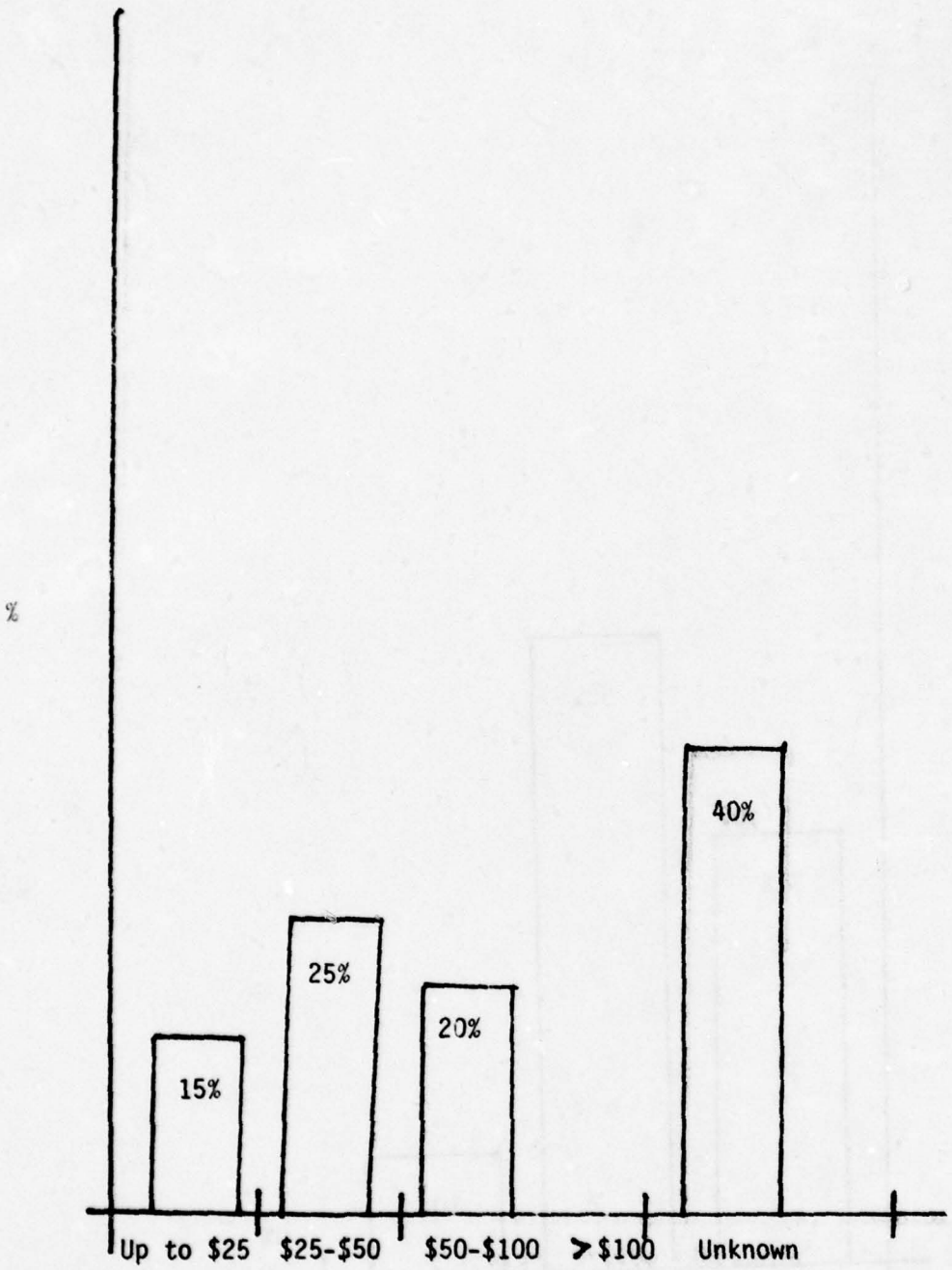


Figure 5-3 Breakdown of Applications Software Cost per Instruction

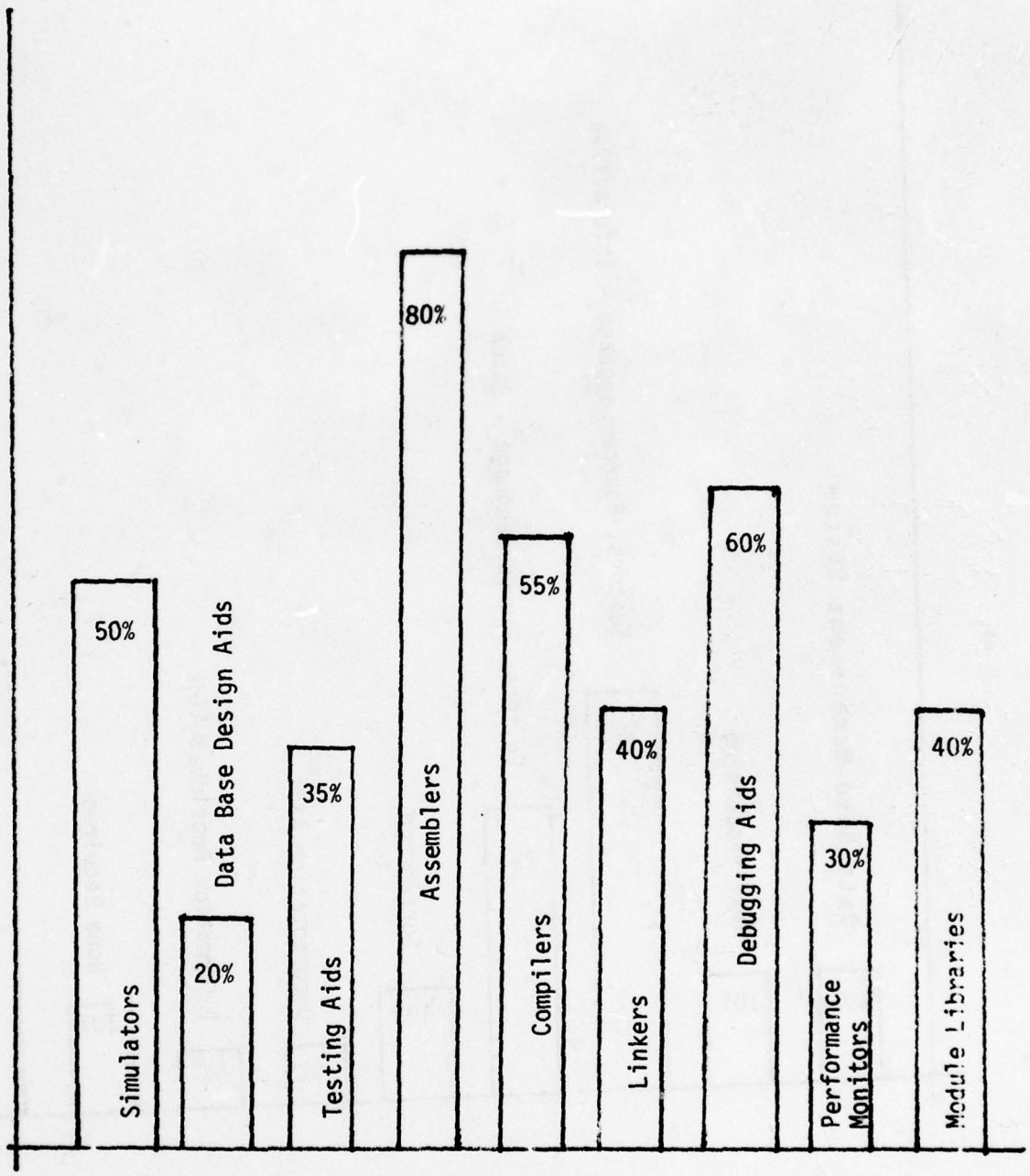


Figure 5-4 Breakdown of System Utilization of Functional Support Software

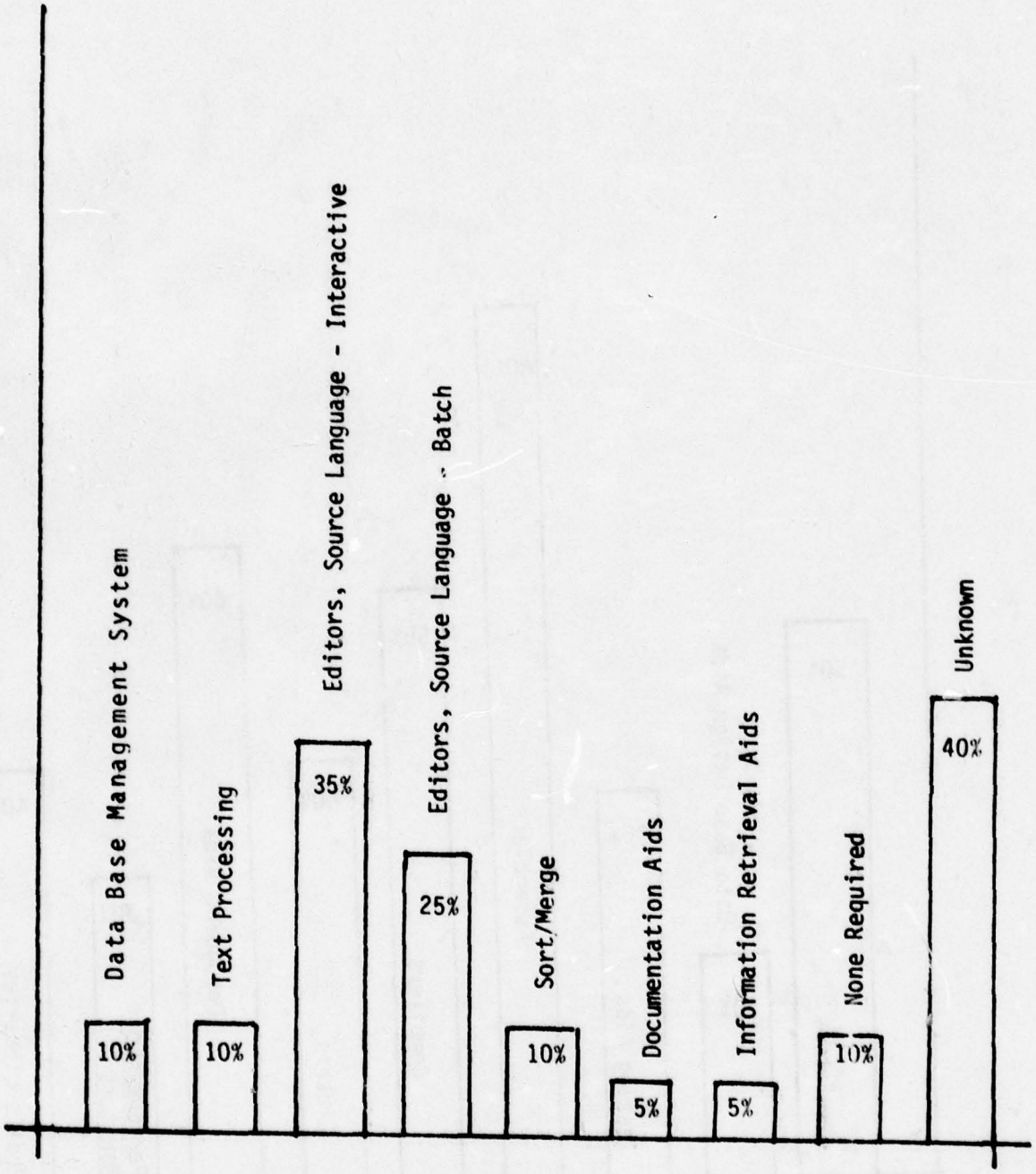


Figure 5-5 Breakdown of System Utilization of General Support Software (General Support Services)

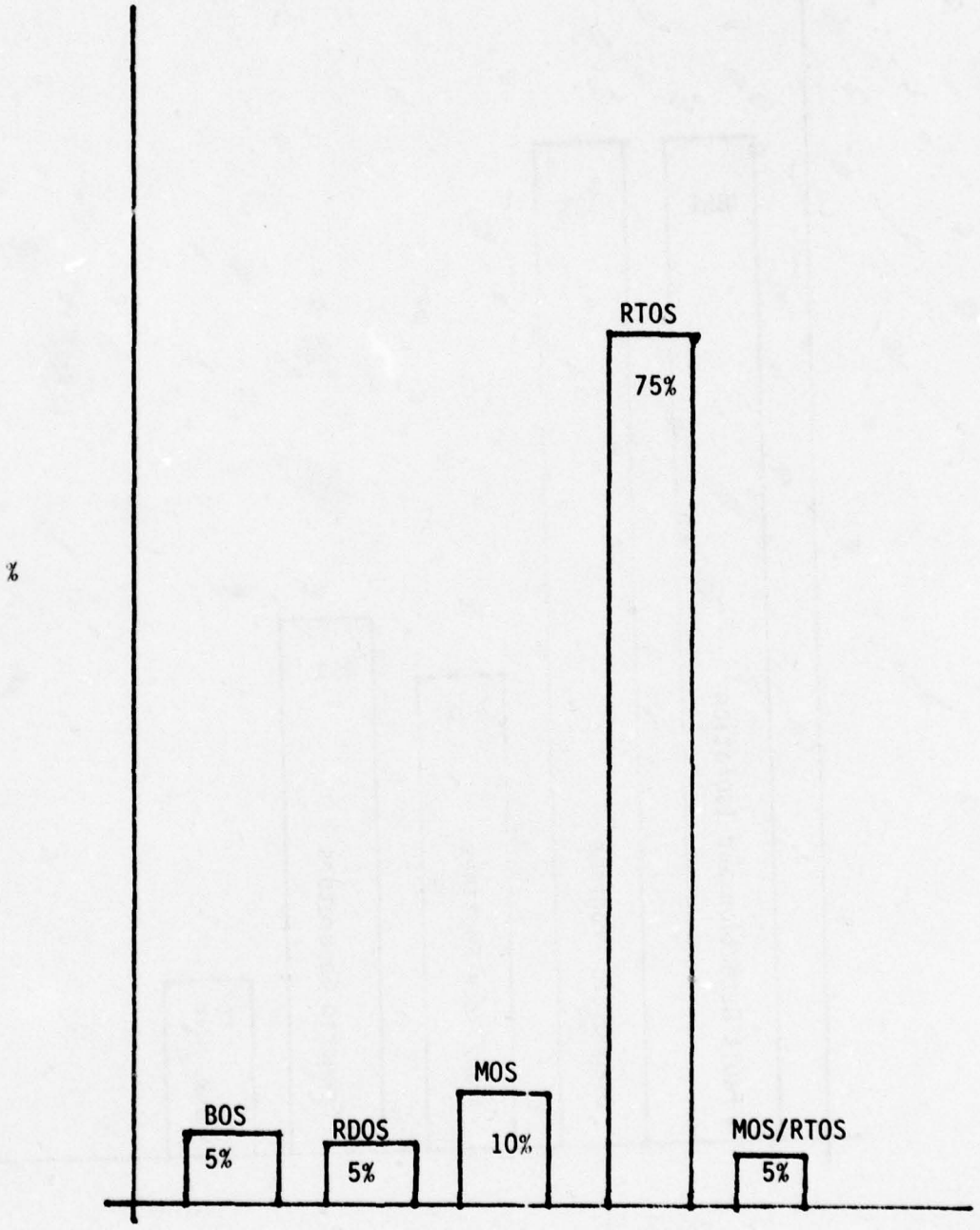


Figure 5-6 Breakdown of Operating System (OS) Usage

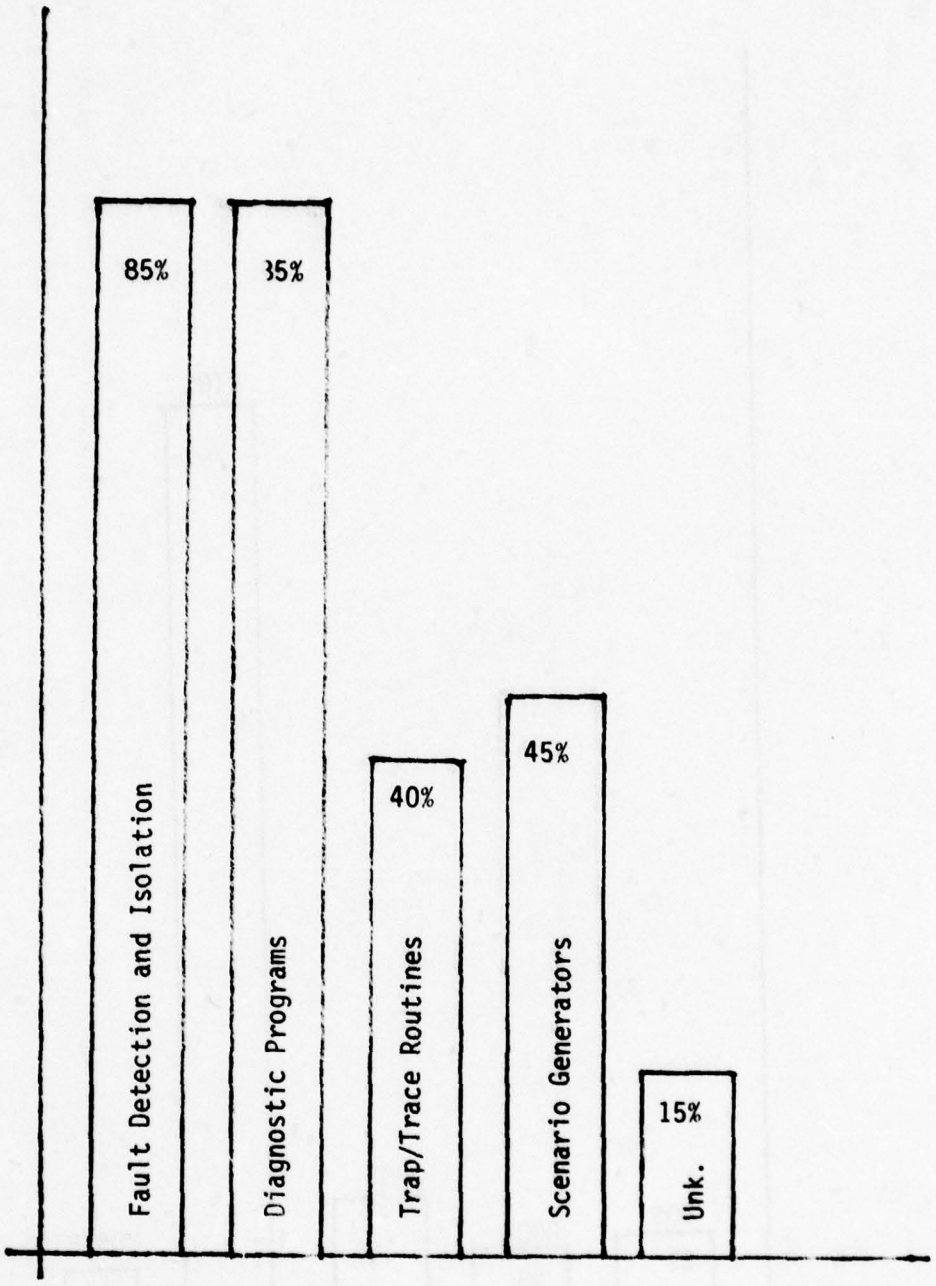


Figure 5-7. Breakdown of Post Deployment Support Software Usage.

## 6. COMPUTER REQUIREMENTS (Total Systems)

As estimate of the total U.S. Army defense systems computer needs for the 1980's is shown in Table 6-1. "MAXIs" are not included since their quantity was found to be too insignificant to be considered.

This interim report indicates 122,000 Micro computers estimated to be required during the 1980's; 10,000 Mini-computers and 3,000 Midi-computers estimated for the 1980's.

No attempt is made to estimate the number of computers by year since the acquisition status of the remaining systems is not known. Also, no attempt was made to estimate other computer resources requirements, such as printers, displays, software type, size, etc. since this type of estimate would be pure conjecture based on the extremely limited knowledge of the remaining systems that are presently listed on the DARCOM "Inventory of Computers In Army Defense Systems".

TABLE 6-1

ESTIMATE OF TOTAL U.S. ARMY DEFENSE SYSTEMS

COMPUTER REQUIREMENTS FOR FY 1978 THROUGH FY 1990

| Number of Systems* | MICRO | MINI | MIDI | MAXI | TOTAL |
|---|---|---|---|---|---|
| 20 | 50,000 | 1,400 | 850 | - | 52,250 |
| 112 | 110,000 | 8,400 | 2,100 | - | 120,500 |
| 130 | 122,000 | 9,500 | 2,300 | - | 133,800 |
| 120 Adj | 122,000 | 10,000 | 3,000 | - | 135,000 |
| Est Avg. Unit Cost | $ 6K | $ 83K | $345K | - | - |
| Est Total Dollar Cost | $730M | $830M | $1040M | - | $2600M |

*For derivation of the "number of systems" see paragraph 2.2

COMPARISON WITH OTHER RELATED DATA

It would be very desirable to get some idea as to how accurate the estimate in Table 6-1 really is. The only other similar study known which can possibly be used for some comparison purpose is the Frost and Sullivan Study Report entitled "The Military Computer Market", dated November 1976. The Frost and Sullivan Report does not speak in computer quantities but rather in dollar value of computer systems (i.e., CPU, Memory, and I/O). Also, it covers only the five year period FY 1977 thru FY 1981.

Therefore, to provide some sort of a comparison, it will be necessary to compare only the computer system (i.e., CPUs, Memory, and I/O only) quantities in this interim report during FY 1978 thru FY 1981 with the same four year period in the Frost and Sullivan Report. This, of course, will not serve as a comparison for the entire ten year period addressed in Table 6-1 but it will at least provide some level of confidence, even if only for the FY 1978 - FY 1981 period. Also, the quantities surveyed as well as those estimated in this interim report will have to be converted to dollars for comparison to the dollars stated in the Frost and Sullivan Study Report.

In converting to dollars, the procedure used is summarized in Table 6-2 and explained in detail below.

For the twenty systems already surveyed in this interim report, the computer quantities and costs* are known and documented in the questionnaires.

By multiplying the actual quantity of computers for the years FY 1978 through FY 1981 only, by the actual dollar cost of those computers, it was found that the twenty systems surveyed represent a computer cost of approximately $140,000,000.

The Frost and Sullivan Report indicates that the U.S. Army will spend $591,000,000 for computer systems during this four year period with 25 percent of that being for missile computer systems, none of which have been included in the initial twenty systems surveyed. The survey of the initial twenty systems therefore accounts for approximately 24 percent of the total computer costs declared by the Frost and Sullivan Report.

The remaining systems yet to be surveyed must have their computer costs estimated. To accomplish this, an "average cost" for a MICRO, MINI and MIDI was computed based on the actual data contained in the initial twenty questionnaires. The MICRO had a reported cost range of $1,500 to $22,400 with an average cost of $5,100. The MINI had a reported cost range of $23,000 to $175,000 with an average cost of $71,000. Finally, the MIDIs had a reported cost range of $260,000 to $475,000 with an average cost of $296,000.

---

*Note: The term "costs" as used throughout this section of the interim report implies "cost to the government, i.e., the price paid by the government". It is not meant to indicate or imply manufacturer's cost or the cost to the supplier prior to normal mark-ups and profit margins usually passed on to the ultimate customer.

In estimating the cost of the remaining computers yet to be surveyed and scheduled to be delivered during the FY 1978 - FY 1981 time period, the average cost was used, i.e., $5,100 for the MICROS, $71,000 for the MINIs, and $296,000 for the MIDIs. However, since the above average costs are based on FY 1977 figures and the average cost desired is not for FY 1977 but for FY 1978 - 1981, an "escalation rate" (for electronics) was used to convert the average computer costs from FY 1977 figures to what they might actually be during the years from FY 1978 to FY 1981. The source for this escalation rate is DARCOM Letter DRCCP-ER, dated 14 December 1976 from BG Alfred J. Cade, Subject: "Inflation Guidance". Based on an FY 1977 Base Year and using compound indices, an average escalation rate of 1.1673 was determined. This escalation rate will be applied over the four-year period FY 1978 - FY 1981. This revises the MICRO average cost of $5,100 in FY 1977 to $6,000 for FY 1978 - FY 1981. Similarly, the MINI average cost of $71,000 in FY 1977 is revised to $83,000 for FY 1978 - FY 1981; and the MIDI average cost of $296,000 in FY 1977 is revised to $346,000 for FY 1978 - FY 1981.

It is now necessary to estimate how many of the remaining computer systems yet to be surveyed will actually be deliverable during the FY 1978 time frame. To estimate this, the data previously collected for the initial twenty systems was used as a "general guide". That is, it was noticed that of all the systems containing MICROs and being deliverable over the entire FY 1978 to FY 1990 time period, 15 percent of those appeared in the FY 1978 - FY 1981 period. Likewise, for the MINIs, this figure was 25 percent and for the MIDIs, this figure was 20 percent. These same percentages were used to estimate the remaining yet to be surveyed computer system quantities. This resulted in the following quantities for the FY 1978 - FY 1981 period:

MICROs = (122,000 - 50,000) x .15 = 10,800 units
MINIs = (10,000 - 1,400) x .25 = 2150 units
MIDIs = (3,000 - 850) x .20 - 430 units

The data acquired during the survey of the initial twenty systems and the estimates derived for the remaining systems are now in a form compatible for comparison with the Frost and Sullivan Study Report cost figure of $591,000,000 for computer systems over the four year period of FY 1978 - FY 1981.

The results of the comparison are shown below for the period FY 1978 - FY 1981.

| | | |
|---|---|---|
| MICRO: | 10,800 units x $6,000 = $64,800,000 | Computers yet to be surveyed and deliverable in FY 1978 - FY 1981 |
| MINI: | 2150 units x $83,000 = $178,400,000 | |
| MIDI: | 430 units x $346,000 = $148,800,000 | |

Sub-total $392,000,000 (Estimated)

Plus the cost calculated from the actual data obtained on the initial twenty questionnaires $140,000,000 (actual)

Total (Approx) $532,000,000 (FY 1978 - FY 1981 only)

As noted previously, for this same FY 1978 to FY 1981 time period, the Frost and Sullivan Study Report indicated the total computer system cost at $591,000,000. The estimated total computer system cost derived above ($532,000,000) is within 10 percent of the Frost and Sullivan figure ($591,000,000). This would tend to confirm the projected estimates with respect to computer system quantities as provided in this interim report (Table 6-1) at least over the four year period FY 1978 - FY 1981 and also serve to provide a fairly good level of confidence over the entire FY 1978 - FY 1990 time period.

TABLE 6-2 FY 1978 - FY 1981 Computer Cost Comparison

| | | MICRO | MINI | MIDI | TOTAL |
|---|---|---|---|---|---|
| (1) | Aver. Unit Cost of Computer (FY 77 Base). (Extracted from Questionnaires) | $ 5.1K | $ 71K | $296K | - |
| (2) | Est. FY 78 - 81 Aver. Unit Cost of Computers (line 1 times 1.1673) | $ 6K | $ 83K | $346K | - |
| (3) | FY 78 - 90 Qty yet to be surveyed. (Table 6-1; line 4 minus line 1) | 72,000 | 8,600 | 2,150 | 82,750 |
| (4) | Est. % of (3) deliverable during FY 78 - 81 | 15% | 25% | 20% | - |
| (5) | FY 78 - 90 Qty yet to be surveyed AND with delivery scheduled during FY 78 - 81. (line 3 times line 4) | 10,800 | 2,150 | 430 | $13,380 |
| (6) | Total Est. Cost of FY 78 - 81 computers yet to be surveyed. (line 5 times line 2) | $65M | $178M | $149M | $392M |
| (7) | Total Cost of FY 78 - 81 computers for the initial twenty systems. (Actual Cost & Qty data from Questionnaires) | $52M | $26M | $62M | $140M |
| (8) | Total Est. Cost of ALL FY 78 - 81 Computers. (line 6 plus line 7) | $117M | $204M | $211M | $140M |
| (9) | Frost & Sullivan Total Est. Cost of ALL FY 78 - 81 Computers. | - | - | - | $591M |

## ACKNOWLEDGMENT

System Development Corporation received the cooperation of numerous people during the conduct of the initial U.S. Army Defense Systems Computer Resources Requirements Survey. SDC wishes to express its sincere thanks to those that made significant contributions to the success of this initial survey. In appreciation, SDC extends its graditude and acknowledges the contributions of the survey participants listed on the following page.

## ACKNOWLEDGMENT

PM AFTADS

Col. E. Bjorn
Col. E. Kelley, Jr.
Lt./Col. R. Oswandel
Lt./Col. P. Threefoot
Maj. W. Kennedy
Capt. E. Shaw
Lt. N. Herndon
Mr. N. Atkinson
Mr. C. Brooks
Mr. A. Campi
Mr. D. La Clair
Mr. S. Littman
Mr. P. Lloyd
Mr. D. Lowenstein
Mr. J. Pucilowski
Mr. D. Quagliato
Mr. E. Schwan
Mr. M. Simpson

PM SOTAS

Mr. D. Usechak

PM NAVCON

Mr. R. Baker
Mr. E. Cornelious
Mr. A. Diamind
Mr. C. Lucas
Mr. J. Niemela
Mr. P. Paone
Mr. J. Scott
Mr. S. Sokolowski
Mr. R. Williams

PM REMBASS

Lt./Col. Maylie
Mr. E. Kiser
Mr. T. Rorro

PM ATSS

Mr. J. Kastning
Mr. J. Perrapato

USASATCOMA

Mr. E. Cross
Mr. R. Kurek
Mr. G. LaRue
Mr. M. Samuel
Mr. J. Verrone

PM MSCS

Mr. J. Brigance
Mr. T. Brinker
Mr. J. Del Vecchio
Mr. P. Kirzow
Mr. W. Lucas

PM FIREFINDER

Lt./Col. S. Boylan
Lt./Col. J. Ott
Maj. J. Hern
Mr. W. Porter

## 7. APPENDIX A - QUESTIONNAIRE

This section, Appendix A, contains a blank copy of the questionnaire used by System Development Corporation during the conduct of the computer resource requirements survey. The addendum to this report contains two additional appendices (Appendix B and Appendix C).

Appendix B contains a copy of the DARCOM letter issued on 6 May 1977 requesting personal support in the preparation of the computer resource requirements survey and requesting the identification of points of contact.

Appendix C lists the points of contact that were supplied to CENTACS/ARTADS in response to the DARCOM letter in Appendix B.

# APPENDIX A

## Computer Resource Requirements

## Survey Ouestionnaire

REF NO._____ DATE_____

ALSO SEE NOS._____

# TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(A GUIDE FOR THE INTERVIEWER)

SYSTEM PROJECT NAME_____

MNEMONIC_____ USER_____

PM OFFICE:_____

| NAME OF PERSON(S) INTERVIEWED | NAME OF PROGRAM MANAGER | NAME OF "POINT OF CONTACT" FOR ADDITIONAL INFORMATION |
|---|---|---|
| _____ | _____ | |
| _____ | MAILING ADDRESS: | _____ |
| _____ | _____ | MAILING ADDRESS: |
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| NAME OF DEPUTY PROGRAM MANAGER | TELEPHONE NO. (COMM/AUTOVON) | TELEPHONE NO. (COMM/AUTOVON) |
| _____ | (  )_____ | (  )_____ |
| | AV_____ | AV_____ |

COMMENTS:

_____

_____

_____

6/77

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

TABLE OF CONTENTS

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

INTRODUCTION

A brief introduction (narrative) to the subsystem being described in this questionnaire. Include an illustration showing how the subsystem forms a part of the total

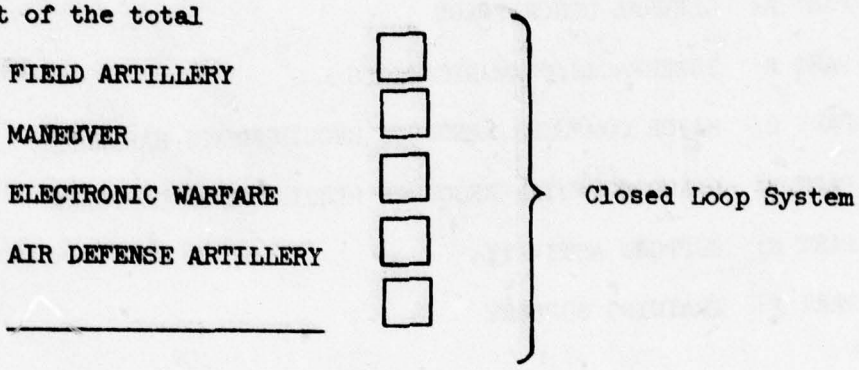


Figure 1. Simplified _____ Closed Loop Subsystem.

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART A: GENERAL DESCRIPTION

A.1 SYSTEM PICTORIAL REPRESENTATION

(Simplified _____Closed Loop System)

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART A: GENERAL DESCRIPTION (Continued)

A.2 What are the prime functional requirements or mission(s) of this subsystem? _____

A.3 Is this subsystem intended to replace or upgrade an existing subsystem?

NO ☐ YES ☐

If YES, explain . . .

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART A: GENERAL DESCRIPTION (Continued)

A.4 What are the major physical/environmental requirements?

A.5 At what echelon(s) will deployment occur?

CORPS ☐ DIVISION ☐ BATTALION ☐

BATTERY ☐ GROUP ☐ OTHER ☐

A.6 Will operation occur in a tactical environment? YES ☐ NO ☐

If YES, will the subsystem be militarized?

YES ☐ NO ☐

FULLY ☐

PARTIALLY ☐

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART A: GENERAL DESCRIPTION (Continued)

A.7 Identify and briefly describe the input stimuli and the output response(s) with respect to the subsystem described in this questionnaire.

INPUT(S):

OUTPUT(S):

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART A: GENERAL DESCRIPTION (Continued)

A.8 OVERALL SUBSYSTEM PICTORIAL

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART A: GENERAL DESCRIPTION (Continued)

A.9 Show the subsystem level block diagram.

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART A: GENERAL DESCRIPTION (Continued)

A.10 Provide a brief narrative describing the subsystem configuration.

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART A: GENERAL DESCRIPTION (Continued)

A.11 What is the estimated life span of this subsystem? _____years.

A.12 Is this subsystem, in total, also a part of any other subsystem?

YES ☐ NO ☐

If YES, explain _____

_____

_____

A.13 At the present time, where does this subsystem appear in the "Acquisition Cycle"?

| Pre-Concept | Conceptual | Validation | Full Scale Development | Production and Deployment | | | Fully Operational |
|---|---|---|---|---|---|---|---|
| | | AD | ED | LRIP | FSP | Deployment | |
| | | | | | | | |

*

*Type of development, procurement, or authorization following ED:

LP ☐ CONTINGENCY ☐ STANDARD ☐ OBSOLETE ☐

A.14 Indicate the major milestone schedule for this subsystem, i.e., DT/OT, ASARC/DSARC, etc.

△ △ △ △ △

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART A: GENERAL DESCRIPTION (Continued)

A.15 What is the total subsystem delivery schedule with respect to DoD and foreign governments (delivery from the developer)?

| FY | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | |
| Advanced Development | | | | | | | | | | | | | |
| Engineering Development | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Low Rate Initial Prod. | | | | | | | | | | | | | |
| Full Scale Production | | | | | | | | | | | | | |

SEE APPENDIX A, TABLE A.

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total DoD | | | | | | | | | | | | | |
| Foreign Gov'ts | | | | | | | | | | | | | |

A.16 What is the subsystem production unit price based on the above quantities? SEE APPENDIX A, TABLE B.

DoD Subsystems $_____

Foreign Government Subsystems $_____

} Based on FY _____ Dollars

NOTE

Include question C.16 at this point (Page C-9)

END OF PART A

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART B: INTERFACES/COMMUNICATIONS

B.1 Identify the major EXTERNAL subsystem interfaces.

B.2 Identify the major INTERNAL subsystem interfaces with the computer group?

B.3 Does the subsystem include provisions for interfacing with external interfaces listed in B.1?

YES ☐ NO ☐

If NO, explain...

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART B: INTERFACES/COMMUNICATIONS (Continued)

B.4 Describe the basic information characteristics of each interface identified in B.1 and B.2.

ANALOG ☐ DIGITAL ☐

SERIAL ☐ PARALLEL ☐

BANDWIDTH _____ BYTE ☐

WORD ☐

ASYNCRONOUS ☐ SYCHRONOUS ☐

SPEED _____ BITS/SEC

B.5 Describe the basic communications characteristics of each interface identified in B.1 and B.2

CODE FORMAT: ASCII ☐ BAUDOT ☐ FIELDATA ☐

INTRA-ARMY ☐ OTHER _____

PROTOCOL: _____

_____

ENCRYPTED DATA ☐ CLEAR TEXT ☐

DEDICATED LINK ☐ NETTED LINK ☐

SIMPLEX ☐ HALF DUPLEX ☐ FULL DUPLEX ☐

OTHER: (BLOCK FORMATION, TIME DISPERSED CODING, ETC.) _____

_____

_____

_____

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART B: INTERFACES/COMMUNICATIONS (Continued)

B.6 Describe the major characteristics of the communications equipment/system used to transmit and receive information over the subsystem interfaces identified in B.1 and B.2 (include nomenclature, if known).

RADIO ☐ WIRE ☐ SATELLITE ☐

NOMENCLATURE _____

IF RADIO, AM ☐ _____ FM ☐ _____

SINGLE CHANNEL ☐ MULTICHANNEL ☐

MULTIPLEXERS...

YES ☐ NO ☐

IF YES,

TDM ☐ FDM ☐

OTHER ... _____

_____

_____

END OF PART B

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART C: MAJOR COMPUTER RESOURCE ELEMENTS - HARDWARE

C.1 What is the configuration of the computer group:

- Block Diagram -

- Brief Narrative - _____

_____

_____

_____

_____

_____

_____

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART C: MAJOR COMPUTER RESOURCE ELEMENTS - HARDWARE (Continued)

C.2 How many computers are used in this subsystem?

(Include master-slave relationships, duplex operation, standby backup, off-line redundancy, multiprocessor and/or multi-computer configuration, etc.) _____

_____

_____

_____

C.3 What are the major functions performed by the computer(s)?

_____

_____

_____

_____

_____

C.4 Are any of the computers microprogrammable?

NO ☐ YES ☐ _____

- If YES, is the microprogrammable computer emulating another computer? YES ☐ NO ☐

- If YES, what computer is being emulated? _____

_____

_____

_____

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART C: MAJOR COMPUTER RESOURCE ELEMENTS - HARDWARE (Continued)

C.5 The computer(s) used in this subsystem may be categorized as ...

- GROUND, FIXED ☐
- GROUND, MOBILE ☐
- AIRBORNE ☐
- MISSILEBORNE ☐
- SPACEBORNE ☐
- GROUND SUPPORT EQUIPMENT ☐
- TEST EQUIPMENT ☐
- MULTIPROCESSORS ☐
- MULTICOMPUTERS ☐
- OTHER ☐ _____

C.6 For each CPU, complete the following:

| COMPUTER MFGR/MODEL (NOMENCLATURE) | EXECUTION TIME (μs) | | MAXIMUM ADDRESSABLE MEMORY(K-BYTES) | NUMBER OF... | | REAL TIME CLK? |
|---|---|---|---|---|---|---|
| | ADD | MULT. | | WORKING REGISTERS | INST-RUCTIONS | |
| | | | | | | |

- For each CPU, complete the following:

K=1,024

| BASIC PRIMARY (MAIN) MEMORY CHARACTERISTICS | | | | | | |
|---|---|---|---|---|---|---|
| MEMORY TYPE | CURRENT K-BYTES | MAXIMUM K-BYTES | MODULE SIZE (K-BYTES) | WORD SIZE (BITS) | ACCESS TIME (n-sec) | CYCLE TIME (n-sec) |
| | | | | | | |

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART C: MAJOR COMPUTER RESOURCE ELEMENTS-HARDWARE (Continued)

C.7 Describe the major characteristics of the input/output unit.

- NUMBER OF I/O DEVICE ADDRESSES HANDLED: _____
- I/O SPEEDS: _____
- INTERRUPT CAPABILITY: _____
- WORD WIDTH (BITS): _____
- AUTOMATIC I/O (INDEPENDENT OF CPU): _____
- OTHER: _____
- _____
- _____
- _____

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART C: MAJOR COMPUTER RESOURCE ELEMENTS-HARDWARE (Continued)

C.8 Is there a requirement for secondary memory?

YES ☐ NO ☐

- If YES, indicate the type of secondary memory required.

| | STORAGE CAPACITY PER UNIT (MEGABYTES) | NOMINAL ACCESS TIME (ms) | NUMBER OF STORAGE UNITS PER SUBSYSTEM |
|---|---|---|---|
| DRUM | | | |
| DISK | | | |
| | | | |

C.9 Is there a requirement for tertiary storage?

YES ☐ NO ☐

- If YES, indicate the type of tertiary storage required.

| | STORAGE CAPACITY PER UNIT MEGABYTES | NUMBER OF STORAGE UNITS PER SUBSYSTEM |
|---|---|---|
| TAPE (REEL) | | |
| TAPE (CARTRIDGE) | | |
| TAPE (CASSETTE) | | |
| | | |
| | | |

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART C: MAJOR COMPUTER RESOURCE ELEMENTS-HARDWARE (Continued)

C.10 Is there a requirement for printers?

YES ☐ NO ☐

If YES, indicate the following:

| | PRINT RATE (cps/lpm) | NUMBER OF CHARACTERS PER LINE | NUMBER OF PRINTERS PER SUBSYSTEM |
|---|---|---|---|
| LOW SPEED (10-300 lpm) | | | |
| MED SPEED (UP to 1000 lpm) | | | |
| HIGH SPEED) (> 1000 lpm) | | | |

C.11 Is there a requirement for display devices?

YES ☐ NO ☐

If YES, indicate the following:

| | INTERACTIVE DEVICE | | A/N ONLY ? | A/N PLUS GRAPHICS | NUMBER OF DISPLAY DEVICES PER SUBSYSTEM |
|---|---|---|---|---|---|
| | YES | NO | | | |
| SMALL SCREEN (Up to 12") | | | | | |
| MED SCREEN (12 - 25" | | | | | |
| LARGE SCREEN (> 25") | | | | | |

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART C: MAJOR COMPUTER RESOURCE ELEMENTS-HARDWARE (Continued)

C 12 Is there a requirement for intelligent terminals?

YES ☐ NO ☐

If YES, which of the following two categories would best describe the terminal(s)?

| CATEGORY | QUANTITY PER SUBSYSTEM |
|---|---|
| o PORTABLE ☐ | |
| HANDHELD ☐ | _____ |
| MAN-PACK ☐ | |
| _____ ☐ | |
| o CONSOLE | _____ |
| including, | |
| CRT DISPLAY ☐ | |
| PRINTOUT ☐ | |
| KEYBOARD ☐ | |
| _____ ☐ | |
| _____ ☐ | |

_____

_____

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART C: MAJOR COMPUTER RESOURCE ELEMENTS - HARDWARE (Continued)

C.13 What are the computer interface requirements?

- A/D CONVERTERS:
- D/A CONVERTERS:
- LEVEL/CODE CONVERTERS:
- LINE/CABLE DRIVERS:
-

C.14 List the characteristics of any other peripherals required in the subsystem.

- PAPER TAPE READER/PUNCH: _____
- CARD READER/PUNCH: _____
- CONSOLES: _____
- KEYPUNCH: _____
- NON-INTELLIGENT TERMINALS: _____
-
-

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART C: MAJOR COMPUTER RESOURCE ELEMENTS - HARDWARE (Continued)

C.15 Identify any security features that are designed into the subsystem.

☐ MESSAGE ACCOUNTABILITY (ACCESS CONTROLS/DISSEMINATION CONTROLS):

☐ PRIVILEGED INSTRUCTIONS:

☐ TEMPEST:

☐ COMSEC:

☐ PROTECTED FILES:

☐

☐

C.16 What is the computer (CPU, main memory, and I/O) production unit price? SEE APPENDIX A, TABLE B.

$_____ in FY_____DOLLARS

END OF PART C

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART D: MAJOR COMPUTER RESOURCE ELEMENTS - SOFTWARE

D.1 What computer software language(s) are applicable to this computer based subsystem?

- MACHINE ORIENTED LANGUAGE - (MOL). ☐
- HIGH ORDER LANGUAGE - (HOL). ☐

| | | |
|---|---|---|
| CMS - 2 ☐ | JOVIAL ☐ | COBOL ☐ |
| SPL -1 ☐ | TACPOL ☐ | FORTRAN ☐ |
| _____ ☐ | _____ ☐ | _____ ☐ |

What "VERSION" is used? _____

_____

D.2 What is the approximate number of source statements required for the applications software? _____

| | |
|---|---|
| UNDER 10K ☐ | 100K TO 500K ☐ |
| 10K TO 100K ☐ | OVER 500K ☐ |

_____

_____

What do you estimate the per-statement price to be? _____

| | |
|---|---|
| LESS THEN 25$ ☐ | $50 TO $100 ☐ |
| $25 TO $50 ☐ | OVER $100 ☐ |

FY _____ DOLLARS

_____

_____

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART D: MAJOR COMPUTER RESOURCE ELEMENTS - SOFTWARE (Continued)

D.3 What FUNCTIONAL SUPPORT SOFTWARE has been used to provide direct support to the software development activities, i.e., requirements analysis, software design, system tests, building software (coding), unit (module) tests, and maintenance of systems? Discuss briefly - include version identification if applicable.

☐ SIMULATORS:

☐ DATA BASE DESIGN AIDS:

☐ TESTING AIDS:

☐ ASSEMBLERS:

☐ COMPILERS:

☐ LINKERS:

☐ DEBUGGING AIDS:

☐ PERFORMANCE MONITORS:

☐ MODULE LIBRARIES:

☐ _____

☐ _____

If deliverable, indicate with (*).

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART D: MAJOR COMPUTER RESOURCE ELEMENTS - SOFTWARE (Continued)

D.4 What GENERAL SUPPORT SOFTWARE has been used to store, retrieve, organize and transfer the outputs of the FUNCTIONAL SUPPORT SOFTWARE identified in D.3?

- ☐ DATA BASE MANAGEMENT SYSTEM:
- ☐ TEXT PROCESSING:
- ☐ EDITORS, SOURCE LANGUAGE:
  - ☐ INTERACTIVE
  - ☐ BATCH
- ☐ SORT/MERGE:
- ☐ DOCUMENTATION AIDS:
- ☐ INFORMATION RETRIEVAL AIDS:
- ☐ _____
- ☐ _____

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART D: MAJOR COMPUTER RESOURCE ELEMENTS - SOFTWARE (Continued)

D.5 What type(s) of OPERATING SYSTEM SERVICES have been used for this subsystem?

- ☐ BOS - BASIC OS:
- ☐ MOS - MULTIPROGRAM OS:
- ☐ MPOS - MULTIPROCESSOR OS:
- ☐ TSOS - TIMESHARING OS:
- ☐ RTOS - REAL TIME OS:
- ☐ VMM - VIRTUAL MACHINE MONITOR:
- ☐ _____
- ☐ _____

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART D: MAJOR COMPUTER RESOURCE ELEMENTS-SOFTWARE (Continued)

D.6 What POST DEPLOYMENT SUPPORT SOFTWARE is available to provide maintenance support for this subsystem?

☐ FAULT DETECTION AND ISOLATION:

☐ DIAGNOSTIC PROGRAMS:

☐ TRAP/TRACE ROUTINES:

☐ SCENARIO GENERATORS:

☐ _____

☐ _____

☐ _____

☐ _____

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART D: MAJOR COMPUTER RESOURCE ELEMENTS-SOFTWARE (Continued)

D.7 With regard to this subsystem's post-deployment software support....

- Where will the post-deployment software support be performed?

_____

_____

- The post-deployment software support will be performed by...

☐ MILITARY PERSONNEL.

☐ GOVERNMENT EMPLOYEES.

☐ CONTRACTOR SUPPORT PERSONNEL.

☐ COMBINATION OF THE ABOVE.

EXPLAIN: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART D: MAJOR COMPUTER RESOURCE ELEMENTS - SOFTWARE (Continued)

D.8 What government regulations were used during the development of the subsystem's software?

- ☐ DOD DIR 5000.29
- ☐ DOD DIR 5000.31
- ☐ _____
- ☐ _____

- What defining specification document and version applies with respect to the above?

| | |
|---|---|
| ☐ CMS-2 | ☐ CMS-2Y PROGRAMMERS REFERENCE MANUAL. |
| | ☐ CMS-2M COMPUTER PROGRAM PERFORMANCE SPECIFICATION. |
| ☐ SPL-1 | ☐ SPL-1 LANGUAGE REFERENCE MANUAL. |
| ☐ TACPOL | ☐ EL-CG-00043082C (APPENDIX 10). |
| ☐ JOVIAL | ☐ MIL-STD-1588. (J3). |
| | ☐ MIL-STD-1589. (J73). |
| ☐ COBOL | ☐ ANSI X3.23-1974. |
| ☐ FORTRAN | ☐ ANSI X3.9-1974. |
| ☐ _____ | ☐ _____ |
| ☐ _____ | ☐ _____ |

END OF PART D

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART E: SUPPORT ACTIVITY

E.1 Who is responsible for providing the maintenance support for the hardware (following the warantee period, if any)?

☐ CONTRACTOR. ☐ USER.

☐ COMBINATION, EXPLAIN: _____

_____

E.2 Who is responsible for providing the maintenance support for the software (following the warrantee period, if any)?

☐ CONTRACTOR. ☐ USER.

☐ COMBINATION, EXPLAIN: _____

_____

E.3 Who is responsible for configuration management?

| DURING THE... / FOR THE... | ACQUISITION CYCLE | POST-DEPLOYMENT |
|---|---|---|
| USER REQUIREMENTS | | |
| SUBSYSTEM | | |
| HARDWARE | | |
| APPLICATION SOFTWARE | | |
| SUPPORT SOFTWARE | | |

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART E: SUPPORT ACTIVITY (Continued)

E.4 Who is responsible for providing the communications support for the ...

- o COMMUNICATIONS WITH EXTERNAL SUBSYSTEMS? _____

  _____

  _____

- o INTERNAL INTERFACES? _____

  _____

  _____

- o INTERFACES WITH SUPPORTING SUBSYSTEMS? _____

  _____

  _____

- o INTERFACES WITH OTHER SERVICES? _____

  _____

  _____

END OF PART E

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART F: TRAINING SUPPORT

F.1 Identify the computer(s) used to provide training for this subsystem. _____

_____

- For each CPU, complete the following:

| COMPUTER MFGR/MODEL (NOMENCLATURE) | EXECUTION TIME (μs) | | MAXIMUM ADDRESSABLE MEMORY(K-BYTES) | NUMBER OF... | | REAL TIME CLK? |
|---|---|---|---|---|---|---|
| | ADD | MULT. | | WORKING REGISTERS | INST-RUCTIONS | |
| | | | | | | |

- For each CPU, complete the following:

K=1,024

| BASIC PRIMARY (MAIN) MEMORY CHARACTERISTICS | | | | | | |
|---|---|---|---|---|---|---|
| MEMORY TYPE | CURRENT K-BYTES | MAXIMUM K-BYTES | MODULE SIZE (K-BYTES) | WORD SIZE (BITS) | ACCESS TIME (n-sec) | CYCLE TIME (n-sec) |
| | | | | | | |

_____

_____

_____

_____

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART F: TRAINING SUPPORT (Continued)

F.2 What computer software language(s) are applicable to this computer-based training system/device?

MACHINE ORIENTED LANGUAGE - (MOL). ☐

HIGH ORDER LANGUAGE - (HOL). ☐

| | | |
|---|---|---|
| CMS - 2 ☐ | JOVIAL ☐ | COBOL ☐ |
| SPL - 1 ☐ | TACPOL ☐ | FORTRAN ☐ |
| _____ ☐ | _____ ☐ | _____ ☐ |

What "VERSION" is used? _____

TACTICAL COMPUTER RESOURCE REQUIREMENTS SURVEY

(Continued)

PART F: TRAINING SUPPORT (Continued)

F.3 What government regulations were used during the development of the training system software?

- ☐ DOD DIR 5000.29
- ☐ DOD DIR 5000.31
- ☐ _____
- ☐ _____

- What defining specification document and version applies with respect to the above?

| | |
|---|---|
| ☐ CMS-2 | ☐ CMS-2Y PROGRAMMERS REFERENCE MANUAL. |
| | ☐ CMS-2M COMPUTER PROGRAM PERFORMANCE SPECIFICATION. |
| ☐ SPL-1 | ☐ SPL-1 LANGUAGE REFERENCE MANUAL. |
| ☐ TACPOL | ☐ EL-CG-00043082C (APPENDIX 10). |
| ☐ JOVIAL | ☐ MIL-STD-1588. (J3). |
| | ☐ MIL-STD-1589. (J73). |
| ☐ COBOL | ☐ ANSI X3.23-1974. |
| ☐ FORTRAN | ☐ ANSI X3.9-1974. |
| ☐ _____ | ☐ _____ |
| ☐ _____ | ☐ _____ |

PART F: TRAINING SUPPORT (Continued)

F.4 What FUNCTIONAL SUPPORT SOFTWARE has been used to provide direct support to the software development activities for this computer-based training system/device, i.e., requirements analysis, software design, system tests, building software (coding), unit (module) tests, and maintenance of systems? Discuss briefly - include version identification if applicable.

☐ SIMULATORS:

☐ DATA BASE DESIGN AIDS:

☐ TESTING AIDS:

☐ ASSEMBLERS:

☐ COMPILERS

☐ LINKERS:

☐ DEBUGGING AIDS:

☐ PERFORMANCE MONITORS:

☐ MODULE LIBRARIES:

☐ _____

☐ _____

If deliverable, indicate with (*).

END OF PART F

DEPARTMENT OF THE ARMY
HEADQUARTERS
UNITED STATES ARMY
Communications Research & Development Command
FORT MONMOUTH, NEW JERSEY 07703
ATTN
OFFICIAL BUSINESS


POSTAGE AND FEES PAID
DEPARTMENT OF THE ARMY
DOD-314

Hisa-FM-617-78